APPENDIX K

AIR QUALITY AND GHG EMISSIONS CALCULATIONS

Mobilization/Demobilization - All Alternatives

Off-Road Construction Equipment

					Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
Equipment Type	**Equipment Category**	**Number**	**Usage Factor**	**Unit**	**ROG**	**NOX**	**CO**	**PM10**	**PM2.5**	**ROG**	**NOX**	**CO**	**PM10**	**PM2.5**	**Total GHG Emissions (MT CO2e)**
Grader	Graders Composite	1	2	hrs/day	0.17	1.31	0.79	0.07	0.06	0.01	0.05	0.03	0.00	0.00	
Rubber Tired Dozer	Rubber Tired Dozers Composite	2	2	hrs/day	0.73	5.99	2.79	0.25	0.23	0.03	0.22	0.10	0.01	0.01	
Loader	Tractors/Loaders/Backhoes Composite	2	2	hrs/day	0.18	1.21	1.00	0.08	0.07	0.01	0.04	0.04	0.00	0.00	
Crane	Cranes Composite	1	2	hrs/day	0.16	1.37	0.59	0.06	0.05	0.01	0.05	0.02	0.00	0.00	
Backhoe	Tractors/Loaders/Backhoes Composite	2	2	hrs/day	0.18	1.21	1.00	0.08	0.07	0.01	0.04	0.04	0.00	0.00	
Off-Highway Trucks	Off-Highway Trucks Composite	2	2	hrs/day	0.52	4.00	1.60	0.14	0.13	0.02	0.14	0.06	0.00	0.00	
					1.93	15.08	7.77	0.67	0.61	0.07	0.54	0.28	0.02	0.02	67.15

Note: Assumes that construction equipment would operate a few hours per day to mobilize/demobilize in staging areas.

On Road Construction Emissions

					Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
	Trips Per Day	**Distance**	**Average Daily Mileage**	**Total Mileage**	**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**Total GHG Emissions (MT CO2e)**
Heavy-Duty Trucks	38	12	456	32,832	0.30	9.01	1.35	0.23	0.16	0.011	0.324	0.048	0.008	0.006	56
Total			**456**	**32,832**	**0.30**	**9.01**	**1.35**	**0.23**	**0.16**	**0.01**	**0.32**	**0.05**	**0.01**	**0.01**	**55.86**

Note: Assumes 2 heavy-duty trucks trip (one trip each direction) per piece of construction equipment, including dredge and pumps. Truck trips also include delivery of 10,000 feet of pipeline (conservatively assumes 250 pieces of pipe and 2 40-foot sections of pipe per truck for a total of 4 truck trips per day).

					Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
	Total Trips Per Day	**Distance**	**Average Daily Mileage**	**Total Mileage**	**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**Total GHG Emissions (MT CO2e)**
Worker Trips	120	16.8	2,016	145,152	0.23	1.89	4.49	0.29	0.16	0.01	0.07	0.16	0.01	0.01	49.62

Note: Assumes a total of 40 workers per day and 20 visitors per day, consistent with the traffic report for the proposed project.

					Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
Total					**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**Total GHG Emissions (MT CO2e)**
					2.46	25.98	13.60	1.19	0.94	0.09	0.94	0.49	0.04	0.03	172.63

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Number of Construction Days: 72

Site Preparation - All Alternatives

Off-Road Construction Equipment

					Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
Equipment Type	**Equipment Category**	**Number**	**Usage Factor**	**Unit**	**ROG**	**NOX**	**CO**	**PM10**	**PM2.5**	**ROG**	**NOX**	**CO**	**PM10**	**PM2.5**	**Total GHG Emissions (MT CO2e)**
Grader	Graders Composite	1	10	hrs/day	0.86	6.56	3.97	0.33	0.30	0.01	0.08	0.05	0.00	0.00	
Rubber Tired Dozer	Rubber Tired Dozers Composite	1	10	hrs/day	1.82	14.97	6.98	0.62	0.57	0.02	0.18	0.08	0.01	0.01	
Loader	Tractors/Loaders/Backhoes Composite	1	10	hrs/day	0.45	3.02	2.49	0.20	0.18	0.01	0.04	0.03	0.00	0.00	
Crane	Cranes Composite	1	10	hrs/day	0.81	6.83	2.94	0.29	0.26	0.01	0.08	0.04	0.00	0.00	
Off-Highway Trucks	Off-Highway Trucks Composite	1	10	hrs/day	1.29	10.00	4.00	0.35	0.32	0.02	0.12	0.05	0.00	0.00	
					5.22	41.39	20.39	1.78	1.64	0.06	0.50	0.24	0.02	0.02	60.64

On Road Construction Emissions

					Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
	Trips Per Day	**Distance**	**Average Daily Mileage**	**Total Mileage**	**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**Total GHG Emissions (MT CO2e)**
Heavy-Duty Trucks	2	12	24	576	0.02	0.47	0.07	0.01	0.01	0.000	0.006	0.001	0.000	0.000	1
Total			**24**	**576**	**0.02**	**0.47**	**0.07**	**0.01**	**0.01**	**0.00**	**0.01**	**0.00**	**0.00**	**0.00**	**0.98**

Notes: Assumes 1 round-trip truck trip per day to haul any material associated with site preparation.

Haul distance assumes that materials from the site will be hauled off and disposed of at the Mira Mar landfill located approximately 12 miles from the site in San Diego

					Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
	Total Trips	**Distance**	**Average Daily Mileage**	**Total Mileage**	**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**Total GHG Emissions (MT CO2e)**
Worker Trips	120	16.8	2,016	48,384	0.23	1.89	4.49	0.29	0.16	0.00	0.02	0.05	0.00	0.00	16.54

Note: Assumes a total of 40 workers per day and 20 visitors per day, consistent with the traffic report for the proposed project.

					Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
Total					**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**Total GHG Emissions (MT CO2e)**
					5.46	43.75	24.95	2.08	1.81	0.07	0.52	0.30	0.02	0.02	78.16

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Number of Construction Days: 24

Alt 1A - Emissions Summary
Construction

	Daily Emissions (pounds/day)				
	ROG	**NOX**	**CO**	**PM10**	**PM2.5**
Mobilization/Demobilization/Site Preparation	8	70	39	3	3
Phase 1 - Construction Equipment/On-Road Vehicles	23	280	97	51	10
Phase 2 - Construction Equipment/On-Road Vehicles	18	191	70	29	7
Dredging	19	166	79	6	5
Material Disposal	69	630	286	23	21
Total Maximum Daily Emissions	**112**	**1,076**	**462**	**80**	**37**

Operations

	Daily Emissions (pounds/day)				
	ROG	**NOX**	**CO**	**PM10**	**PM2.5**
Construction Equipment	4.66	30.25	19.34	1.17	1.04
Total	4.66	30.25	19.34	1.17	1.04

Alt 1A - Mitigated Emissions Summary
Construction

	Daily Emissions (pounds/day)				
	ROG	**NOX**	**CO**	**PM10**	**PM2.5**
Construction Equipment	14	147	86	49	9
On-Road Vehicles	2	42	11	1	1
Dredging	19	166	79	6	5
Material Disposal	38	347	286	23	21
Total Maximum Daily Emissions	**72**	**702**	**462**	**80**	**37**

Alt 1A - Emissions Summary by Year
Construction

	Annual Emissions (tons)					Annual GHG Emissions (metric tons)
	ROG	NOX	CO	PM10	PM2.5	CO2e
2016/2017						
Mobilization/Demobilization/Site Preparation	0.15	1.46	0.79	0.07	0.06	251
Construction Equipment/On-Road Vehicles	1.36	16.67	5.58	2.77	0.58	2,563
Dredging	1.29	11.22	5.34	0.39	0.36	809
Material Disposal	0.55	5.04	2.28	0.19	0.17	342
Total Annual Emissions	**3.35**	**34.39**	**13.99**	**3.41**	**1.16**	**3,964**
2018						
Mobilization/Demobilization	0.09	0.94	0.49	0.04	0.03	173
Construction Equipment/On-Road Vehicles	0.53	6.27	2.24	1.03	0.22	994
Dredging	0.64	5.61	2.67	0.19	0.18	404
Material Disposal	0.28	2.52	1.14	0.09	0.09	171
Total Annual Emissions	**1.54**	**15.33**	**6.54**	**1.36**	**0.52**	**1,742**

Notes: Assumes that Phase 1 emissions for Alternative 1A occur equally in 2016 and 2017

Operations

	Annual Emissions (tons)					Annual GHG Emissions (metric tons)
	ROG	NOX	CO	PM10	PM2.5	CO2e
2020						
Construction Equipment/On-Road Vehicles	0.06	0.39	0.25	0.02	0.01	92.16
Total	**0.06**	**0.39**	**0.25**	**0.02**	**0.01**	**92.16**

Alt 1A - Emissions Summary by Year
Electric Dredge

	Annual Emissions (tons)					Annual GHG Emissions (metric tons)
	ROG	NOX	CO	PM10	PM2.5	CO2e
2016/2017						
Mobilization/Demobilization/Site Preparation	0.15	1.46	0.79	0.07	0.06	251
Construction Equipment/On-Road Vehicles	1.36	16.67	5.58	2.77	0.58	2,563
Dredging	1.29	11.22	5.34	0.39	0.36	869
Material Disposal	0.55	5.04	2.28	0.19	0.17	342
Total Annual Emissions	**3.35**	**34.39**	**13.99**	**3.41**	**1.16**	**4,025**
2018						
Mobilization/Demobilization	0.09	0.94	0.49	0.04	0.03	173
Construction Equipment/On-Road Vehicles	0.53	6.27	2.24	1.03	0.22	994
Dredging	0.64	5.61	2.67	0.19	0.18	434
Material Disposal	0.28	2.52	1.14	0.09	0.09	171
Total Annual Emissions	**1.54**	**15.33**	**6.54**	**1.36**	**0.52**	**1,772**

Notes: Assumes that Phase 1 emissions for Alternative 1A occur equally in 2016 and 2017

Operations

	Annual Emissions (tons)					Annual GHG Emissions (metric tons)
	ROG	NOX	CO	PM10	PM2.5	CO2e
2020						
Construction Equipment/On-Road Vehicles	0.06	0.39	0.25	0.02	0.01	92.16
Total	**0.06**	**0.39**	**0.25**	**0.02**	**0.01**	**92.16**

Alternative 1A - Phase 1

Off-Road Construction Equipment

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
Equipment Type	Equipment Category	Number	Usage Factor (hrs/day)	Power Rating (hp)	Calculated Time - Rounded (days)	ROG	NOX	CO	PM10	PM2.5	ROG	NOX	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Clear & Grub																
Bulldozer	Rubber Tired Dozers Composite	1	10	300	216	1.48	12.24	4.22	0.51	0.47	0.16	1.32	0.46	0.06	0.05	121.10
Front-end Loaders	Rubber Tired Loaders Composite	1	10	250	216	0.75	6.63	2.31	0.23	0.21	0.08	0.72	0.25	0.02	0.02	98.24
Off-Site Dredge to Beneficial Re-Use Areas																
Booster Pump	Pumps Composite	4	20	750	270	15.39	185.08	61.40	5.46	5.02	2.08	24.99	8.29	0.74	0.68	3,761.51
Haul Unsuitable Material																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	2	10	290	14	1.45	12.12	4.78	0.39	0.36	0.01	0.08	0.03	0.00	0.00	14.68
Utility Road Surface																
Motor Grader	Graders Composite	1	10	150	20	0.87	6.39	4.90	0.35	0.32	0.01	0.06	0.05	0.00	0.00	7.57
Indirect Support																
Front-end Loaders	Rubber Tired Loaders Composite	1	6	250	216	0.45	3.98	1.38	0.14	0.12	0.05	0.43	0.15	0.01	0.01	58.94
Motor Grader	Graders Composite	1	6	150	216	0.52	3.83	2.94	0.21	0.19	0.06	0.41	0.32	0.02	0.02	49.06
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	1	6	290	216	0.44	3.64	1.43	0.12	0.11	0.05	0.39	0.15	0.01	0.01	67.93
Water Truck	Off-Highway Trucks	1	6	175	216	0.51	3.46	3.04	0.19	0.18	0.05	0.37	0.33	0.02	0.02	49.51
Total						**21.85**	**237.36**	**86.41**	**7.60**	**6.99**	**2.54**	**28.78**	**10.03**	**0.89**	**0.82**	**4228.54**

Notes: Assumes construction equipment operates 10 hours per day and 6 days per week. Indirect support equipment operates 6 hours per day.

On Road Construction Emissions

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
	Trips Per Day	Distance	Average Daily Mileage	Calculated Time - Rounded (days)	Total Mileage	ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Clear & Grub																
Dump Truck (7)	42	24	1,008	216	217,728	0.66	19.92	2.98	0.51	0.35	0.07	2.15	0.32	0.06	0.04	370.43
Haul Unsuitable Material																
DumpTruck (10)	8	24	187	14	2,621	0.12	3.70	0.55	0.10	0.07	0.01	0.40	0.06	0.01	0.01	68.79
Utility Road Surface (Agg. Base)																
Dump Truck (7)	33	24	794	20	15,888	0.52	15.70	2.35	0.40	0.28	0.06	1.70	0.25	0.04	0.03	291.93
Indirect Support																
Dump Truck (1)	2	24	48	216	10,368	0.03	0.95	0.14	0.02	0.02	0.00	0.10	0.02	0.00	0.00	17.64
Total			**2,038**	**466**	**246,605**	**1.33**	**40.27**	**6.02**	**1.04**	**0.71**	**0.14**	**4.35**	**0.65**	**0.11**	**0.08**	**748.79**

Notes: Clear & Grub activities assume 1,750 cubic yards of material per day. Utility Road Surface (Agg. Base) dump truck trips assumes 2.1194 tons of stone in 1 cy. Number in () after equipment name represents the number of equipment.
Haul distance assumes that materials from the site will be hauled off and disposed of at the Mira Mar landfill located approximately 24 miles roundtrip from the site in San Diego

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
	Total Trips	Distance	Average Daily Mileage	Total Mileage		ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Worker Trips	120	16.8	2,016	435,456		0.23	1.89	4.49	0.29	0.16	0.02	0.20	0.48	0.03	0.02	148.87

Note: Assumes a total of 40 workers per day and 20 visitors per day, consistent with the traffic report for the proposed project.

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
Total						ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
						23.41	279.52	96.92	8.92	7.86	2.71	33.33	11.16	1.04	0.92	5,126.20

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

40 CFR 98 - Table A-1 to Subpart A. 2014.

Number of Construction Days (assumes 6 days per week for 9 months)	216
Number of Pump Construction Days (assumes 7 days per week for 9 months)	270

Alternative 1A - Phase 2

Off-Road Construction Equipment

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
Equipment Type	Equipment Category	Number	Usage Factor (hrs/day)	Power Rating (hp)	Calculated Time - Rounded (days)	ROG	NOX	CO	PM10	PM2.5	ROG	NOX	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Off-Site Dredge to Beneficial Re-Use Areas																
Booster Pump	Pumps Composite	2	20	750	90	7.70	92.54	30.70	2.73	2.51	0.35	4.16	1.38	0.12	0.11	626.32
Nesting Site/Transitional Areas																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	1	10	290	12	0.73	6.06	2.39	0.20	0.18	0.00	0.04	0.01	0.00	0.00	6.29
Bulldozer	Rubber Tired Dozers Composite	1	10	300	12	1.48	12.24	4.22	0.51	0.47	0.01	0.07	0.03	0.00	0.00	6.73
Off-road Hauler	Off-Highway Trucks Composite	1	10	725	12	2.14	15.93	6.46	0.56	0.51	0.01	0.10	0.04	0.00	0.00	16.18
Install Internal Revetments/Shore Protection																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	2	10	290	39	1.45	12.12	4.78	0.39	0.36	0.03	0.24	0.09	0.01	0.01	40.88
Front-end Loaders	Rubber Tired Loaders Composite	2	10	250	39	1.50	13.25	4.61	0.45	0.42	0.03	0.26	0.09	0.01	0.01	35.47
Indirect Support																
Front-end Loaders	Rubber Tired Loaders Composite	1	6	250	72	0.45	3.98	1.38	0.14	0.12	0.02	0.14	0.05	0.00	0.00	19.65
Motor Grader	Graders Composite	1	6	150	72	0.52	3.83	2.94	0.21	0.19	0.02	0.14	0.11	0.01	0.01	16.35
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	1	6	290	72	0.44	3.64	1.43	0.12	0.11	0.02	0.13	0.05	0.00	0.00	22.64
Water Truck	Off-Highway Trucks	1	6	175	72	0.51	3.46	3.04	0.19	0.18	0.02	0.12	0.11	0.01	0.01	16.50
Total						**16.91**	**167.05**	**61.97**	**5.50**	**5.06**	**0.50**	**5.40**	**1.96**	**0.17**	**0.16**	**807.03**

Notes: Assumes construction equipment operates 10 hours per day and 6 days per week. Indirect support equipment operates 6 hours per day.

On Road Construction Emissions

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
	Trips Per Day	Distance	Average Daily Mileage	Calculated Time - Rounded (days)	Total Mileage	ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Install Internal Revetments/Shore Protection																
Dump Truck (13)	45	24	1,073	39	41,839	0.70	21.20	3.17	0.55	0.37	0.03	0.76	0.11	0.02	0.01	131.41
Indirect Support																
Dump Truck	2	24	48	72	3,456	0.03	0.95	0.14	0.02	0.02	0.00	0.03	0.01	0.00	0.00	5.88
Total			**1,121**	**111**	**45,295**	**0.73**	**22.15**	**3.31**	**0.57**	**0.39**	**0.03**	**0.80**	**0.12**	**0.02**	**0.01**	**137.29**

Notes: Install Internal Revetments/Shore Protection dump truck trips assumes 2.1194 tons of stone in 1 cy. Number in () after equipment name represents the number of equipment.
Haul distance assumes that materials from the site will be hauled off and disposed of at the Mira Mar landfill located approximately 24 miles roundtrip from the site in San Diego

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
	Total Trips	Distance	Average Daily Mileage	Total Mileage		ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Worker Trips	120	16.8	2,016	145,152		0.23	1.89	4.49	0.29	0.16	0.01	0.07	0.16	0.01	0.01	49.62

Note: Assumes a total of 40 workers per day and 20 visitors per day, consistent with the traffic report for the proposed project.

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
Total						ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
						17.86	191.09	69.76	6.36	5.61	0.53	6.27	2.24	0.20	0.18	993.95

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

40 CFR 98 - Table A-1 to Subpart A. 2014.

Number of Construction Days (assumes 6 days per week for 3 months)	72
Number of Pump Construction Days (assumes 7 days per week for 3 months)	90

Alternative 1A - Dredge Emissions

Assumptions

Main Generator Engine	855	bhp
	637.6	kW
Aux Generator Engines	445	bhp
	331.8	kW
Number	1.0	

			Emissions (pounds per day)						Emissions (tons per phase)					Emissions (metric tons per phase)
Activity	Number of Construction Days	Time (hours per day)	ROG	NOx	CO	PM10	PM2.5	CO2e*	ROG	NOx	CO	PM10	PM2.5	CO2e*
Dredge	270	20	19.09	166.19	79.05	5.72	5.26	13,167.86	2.58	22.44	10.67	0.77	0.71	1,617.67

*To account for N20 and CH4 emissions, an extra 5% was added to the CO2 emissions.

Main Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
1000 hp	0.70	7.19	2.92	0.29	0.26	652	184.16

Note: CO2 emission factor in g/kWh

Source: ARB Harborcraft Emission Inventory Database

Auxiliary Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
500 hp	0.81	6.05	3.35	0.21	0.19	652	184.16

Note: CO2 emission factor in g/kWh.

Source: ARB Harborcraft Emission Inventory Database

CO2 emissions factor from Port of Long Beach. 2011 Emissions Inventory. Available at http://www.polb.com/environment/air/emissions.asp.

Load Factor

Engine	Load factor
Propulsion	0.45
Auxiliary	0.45

Source: ARB. Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

Table II-4 Fuel Correction Factor

Calendar Years	Horsepower Range	Model Years	NOx	PM
1994-2006	<25	Pre-1995	0.930	0.750
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.822
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
2007+	<25	Pre-1995	0.930	0.720
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.800
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
	All	2011+	0.948	0.852

Source: Off-road Exhaust Emissions Inventory Fuel Correction Factors *(2)*

Calendar Years	Horsepower Range	Model Years	NOx	PM
2007+	All	2011+	0.948	0.852

Source: ARB, Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

The basic equation for the estimating emissions from a commercial harbor craft engine is:

$$E = EF_0 \times F \times (1 + D \times \frac{A}{UL}) \times HP \times LF \times Hr$$

Where:

E is the amount of emissions of a pollutant (ROG, CO, NOx, or PM) emitted during one period; [7]
EF₀ is the model year, horsepower and engine use (propulsion or auxiliary) specific zero hour emission factor (when engine is new);
F is the fuel correction factor which accounts for emission reduction benefits from burning cleaner fuel;
D is the horsepower and pollutant specific engine deterioration factor, which is the percentage increase of emission factors at the end of the useful life of the engine;
A is the age of the engine when the emissions are estimated;
UL is the vessel type and engine use specific engine useful life;
HP is rated horsepower of the engine;
LF is the vessel type and engine use specific engine load factor;
Hr is the number of annual operating hours of the engine.

Alternative 1A - Electric Dredge Emissions

Assumptions

Main Generator Engine	855	bhp
	637.6	kW
Aux Generator Engines	445	bhp
	331.8	kW
Total kW	969.4	

				Emissions (pounds per day)	Emissions (metric tons per phase)
Activity	**Number of Construction Days**	**Time (hours per day)**	**Daily Energy Consumption (kWh)**	**CO2e***	**CO2e***
Dredge	270	20	19,387.94	14,147.19	1,737.98

	Emission Factors (lb/MWh)
CO_2	720.490
N_2O	0.029
CH_4	0.010

Source: Climate Action Registry, 2012. SDG&E 2009 Annual Entity Emissions: Electric Power Generation/Electric Utility Sector.

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Alternative 1A - Material Disposal

Assumptions

Main Generator Engine	5000 bhp
	3728.5 kW
Aux Generator Engines	3000 bhp
	2237.1 kW
Number	1.0

Activity	Number of One-Way Trips	Time (hours per day)	Emissions (pounds per day) ROG	NOx	CO	PM10	PM2.5	Emissions (tons per phase) ROG	NOx	CO	PM10	PM2.5	Emissions (metric tons per phase) CO2e*
Tug/Barge	32	11.583	69.33	630.50	285.58	23.33	21.46	1.11	10.09	4.57	0.37	0.34	683.31

Notes: Assumes 1 tug round trip per day. Each tug would transport 2 barges per trip. Material disposal would only occur during Phase 1 of the proposed project or alternative.
*To account for N20 and CH4 emissions, an extra 5% was added to the CO2 emissions.

Main Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
5000 hp	0.70	7.42	2.92	0.31	0.29	652	184.16

4.17 0.39
44% 45%

Note: CO2 emission factor in g/kWh

Source: ARB Harborcraft Emission Inventory Database

Auxiliary Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
3300 hp	0.84	6.93	3.42	0.27	0.25	652	184.16

Note: CO2 emission factor in g/kWh

Source: ARB Harborcraft Emission Inventory Database

CO2 emissions factor from Port of Long Beach. 2011 Emissions Inventory. Available at http://www.polb.com/environment/air/emissions.asp.

Load Factor

Engine	Load factor
Propulsion	0.45
Auxiliary	0.45

Source: ARB. Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

Table II-4 Fuel Correction Factor

Calendar Years	Horsepower Range	Model Years	NOx	PM
1994-2006	<25	Pre-1995	0.930	0.750
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.822
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
2007+	<25	Pre-1995	0.930	0.720
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.800
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
	All	2011+	0.948	0.852

Source: Off-road Exhaust Emissions Inventory Fuel Correction Factors *(2)*
Rev. 10/2006

The basic equation for the estimating emissions from a commercial harbor craft engine is:

$$E = EF_0 \times F \times (1 + D \times \frac{A}{UL}) \times HP \times LF \times Hr$$

Where:

E is the amount of emissions of a pollutant (ROG, CO, NOx, or PM) emitted during one period; [7]
EF_0 is the model year, horsepower and engine use (propulsion or auxiliary) specific zero hour emission factor (when engine is new);
F is the fuel correction factor which accounts for emission reduction benefits from burning cleaner fuel;
D is the horsepower and pollutant specific engine deterioration factor, which is the percentage increase of emission factors at the end of the useful life of the engine;
A is the age of the engine when the emissions are estimated;
UL is the vessel type and engine use specific engine useful life;
HP is rated horsepower of the engine;
LF is the vessel type and engine use specific engine load factor;
Hr is the number of annual operating hours of the engine.

Alternative 1A - Operations

Off-Road Construction Equipment

					Emissions Summary (lbs/day)					Emissions Summary (tons/year)					
Equipment Type	Equipment Category	Number	Usage Factor	Unit	ROG	NOX	CO	PM10	PM2.5	ROG	NOX	CO	PM10	PM2.5	Total GHG Emissions (Metric Tons)
Rubber Tired Dozer	Rubber Tired Dozers Composite	1	10	hrs/day	1.42	10.57	5.36	0.42	0.39	0.02	0.14	0.07	0.01	0.01	
Backhoe	Tractors/Loaders/Backhoes Composite	1	10	hrs/day	0.29	1.84	2.42	0.09	0.08	0.00	0.02	0.03	0.00	0.00	
Off-Highway Trucks	Off-Highway Trucks Composite	3	10	hrs/day	2.90	16.70	11.08	0.56	0.52	0.04	0.22	0.14	0.01	0.01	
					4.61	29.10	18.87	1.08	0.99	0.06	0.38	0.25	0.01	0.01	86.19

On Road Construction Emissions

					Emissions Summary (lbs/day)					Emissions Summary (tons/year)					
	Trips Per Day	Distance	Average Daily Mileage	Total Mileage	ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (Metric Tons)
Heavy-Duty Trucks	2	12	24	624	0.01	0.22	0.05	0.01	0.01	0.000	0.003	0.001	0.000	0.000	1
Total			**24**	**624**	**0.01**	**0.22**	**0.05**	**0.01**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.97**

Note: Assumes 1 miscellaneous round truck trip per day.

					Emissions Summary (lbs/day)					Emissions Summary (tons/year)					
	Total Trips	Distance	Average Daily Mileage	Total Mileage	ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (Metric Tons)
Worker Trips	40	16.8	672	17,472	0.04	0.93	0.42	0.08	0.04	0.00	0.01	0.01	0.00	0.00	5.00

Note: Assumes a total of 20 workers per day.

					Emissions Summary (lbs/day)					Emissions Summary (tons/year)					
Total					ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (Metric Tons)
					4.66	30.25	19.34	1.17	1.04	0.06	0.39	0.25	0.02	0.01	92.16

Global Warming Potentia

Gas	Atmospheric Lifetime (years	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Number of Construction Days 26

Alt 1B - Emissions Summary
Construction

	Total Daily Emissions (pounds/day)				
	ROG	**NOX**	**CO**	**PM10**	**PM2.5**
Phase 1					
Mobilization/Demobilization/Site Preparation	8	70	39	3	3
Construction Equipment/On-Road Vehicles	26	297	103	50	11
Dredging	48	448	199	16	15
Material Disposal	13	116	52	4	4
Phase 1 - Maximum Daily Emissions	**87**	**861**	**355**	**71**	**29**
Phase 2					
Construction Equipment/On-Road Vehicles	30	305	108	54	11
Dredging	48	448	199	16	15
Phase 2 - Maximum Daily Emissions	**78**	**753**	**307**	**70**	**26**
Phase 3					
Construction Equipment/On-Road Vehicles	30	305	108	54	11
Dredging	48	448	199	16	15
Phase 3 - Maximum Daily Annual Emissions	**78**	**753**	**307**	**70**	**26**
Phase 4					
Mobilization/Demobilization	2	26	14	1	1
Construction Equipment/On-Road Vehicles	26	251	95	40	10
Dredging	48	448	199	16	15
Phase 4 - Maximum Daily Emissions	**76**	**725**	**308**	**58**	**25**

Operations

	Total Daily Emissions (pounds/day)				
	ROG	**NOX**	**CO**	**PM10**	**PM2.5**
Dry Construction Emissions	4.66	30.25	19.34	1.17	1.04
Total Operational Emissions	**4.66**	**30.25**	**19.34**	**1.17**	**1.04**

Alt 1B - Mitigated Emissions Summary
Construction

	Total Daily Emissions (pounds/day)				
	ROG	**NOX**	**CO**	**PM10**	**PM2.5**
Phase 1					
Construction Equipment	15	159	93	49	10
On-Road Vehicles	2	41	10	1	1
Dredging	48	448	199	16	15
Material Disposal	7	64	52	4	4
Phase 1 - Maximum Daily Emissions	**72**	**711**	**355**	**71**	**29**

Alt 1B - Annual Emissions Summary
Construction

	Annual Emissions (tons)					Annual GHG Emissions (metric tons)
	ROG	NOX	CO	PM10	PM2.5	CO2e
2016						
Mobilization/Demobilization/Site Preparation	0.15	1.46	0.79	0.07	0.06	251
Construction Equipment/On-Road Vehicles	1.36	15.87	5.73	3.05	0.58	2,447
Dredging	3.77	35.02	15.57	1.26	1.16	2,386
Material Disposal	0.22	1.98	0.90	0.07	0.07	134
Total Annual Emissions	**5.51**	**54.33**	**22.98**	**4.44**	**1.86**	**5,218**
2017						
Construction Equipment/On-Road Vehicles	2.48	28.68	10.31	5.76	1.07	4,401
Dredging	7.07	65.67	29.19	2.36	2.17	4,474
Material Disposal	0.32	2.95	1.34	0.11	0.10	200
Total Annual Emissions	**9.88**	**97.30**	**40.84**	**8.22**	**3.34**	**9,076**
2018						
Construction Equipment/On-Road Vehicles	2.20	23.99	8.65	6.06	0.99	3,575
Dredging	7.25	67.35	29.94	2.42	2.22	4,589
Total Annual Emissions	**9.45**	**91.35**	**38.60**	**8.48**	**3.22**	**8,164**
2019						
Mobilization/Demobilization/Site Preparation	0.09	0.94	0.49	0.04	0.03	173
Construction Equipment/On-Road Vehicles	1.47	15.41	5.77	3.45	0.63	2,264
Dredging	5.05	46.89	20.85	1.68	1.55	3,195
Total Annual Emissions	**6.60**	**63.23**	**27.11**	**5.17**	**2.21**	**5,632**

Operations

	Annual Emissions (tons)					Annual GHG Emissions (metric tons)
	ROG	NOX	CO	PM10	PM2.5	CO2e
2020						
Construction Equipment/On-Road Vehicles	0.07	0.45	0.29	0.02	0.02	106.34
Total	**0.07**	**0.45**	**0.29**	**0.02**	**0.02**	**106.34**

Alt 1B - Annual Emissions Summary
Electric Dredge

	Annual GHG Emissions (metric tons)
	CO2e
2016	
Mobilization/Demobilization/Site Preparation	251
Construction Equipment/On-Road Vehicles	2,447
Dredging	2,564
Material Disposal	134
Total Annual Emissions	**5,396**
2017	
Construction Equipment/On-Road Vehicles	4,401
Dredging	4,807
Material Disposal	200
Total Annual Emissions	**9,408**
2018	
Construction Equipment/On-Road Vehicles	3,575
Dredging	4,931
Total Annual Emissions	**8,505**
2019	
Mobilization/Demobilization/Site Preparation	173
Construction Equipment/On-Road Vehicles	2,264
Dredging	3,433
Total Annual Emissions	**5,869**

Operations

	Annual GHG Emissions (metric tons)
	CO2e
2020	
Construction Equipment/On-Road Vehicles	106
Total	**106**

Alternative 1B - Construction - Phase 1

Off-Road Construction Equipment

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
Equipment Type	Equipment Category	Number	Usage Factor (hrs/day)	Power Rating (hp)	Calculated Time - Rounded (days)	ROG	NOX	CO	PM10	PM2.5	ROG	NOX	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Clear & Grub																
Bulldozer	Rubber Tired Dozers Composite	2	10	300	14	2.96	24.49	8.45	1.02	0.94	0.02	0.17	0.06	0.01	0.01	15.70
Front-end Loaders	Rubber Tired Loaders Composite	2	10	250	14	1.50	13.25	4.61	0.45	0.42	0.01	0.09	0.03	0.00	0.00	12.73
Off-Site Dredge to Beneficial Re-Use Areas																
Booster Pump	Pumps Composite	4	20	750	390	15.39	185.08	61.40	5.46	5.02	3.00	36.09	11.97	1.06	0.98	5,433.30
Haul Unsuitable Material																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	2	10	290	14	1.45	12.12	4.78	0.39	0.36	0.01	0.08	0.03	0.00	0.00	14.68
Utility Road Surface																
Motor Grader	Graders Composite	1	10	150	20	0.87	6.39	4.90	0.35	0.32	0.01	0.06	0.05	0.00	0.00	7.57
Indirect Support																
Front-end Loaders	Rubber Tired Loaders Composite	1	6	250	312	0.45	3.98	1.38	0.14	0.12	0.07	0.62	0.22	0.02	0.02	85.14
Motor Grader	Graders Composite	1	6	150	312	0.52	3.83	2.94	0.21	0.19	0.08	0.60	0.46	0.03	0.03	70.86
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	1	6	290	312	0.44	3.64	1.43	0.12	0.11	0.07	0.57	0.22	0.02	0.02	98.12
Water Truck	Off-Highway Trucks	1	6	175	312	0.51	3.46	3.04	0.19	0.18	0.08	0.54	0.47	0.03	0.03	71.52
Total						**24.08**	**256.23**	**92.94**	**8.33**	**7.67**	**3.35**	**38.83**	**13.52**	**1.18**	**1.09**	**5,809.62**

On Road Construction Emissions

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
	Trips Per Day	Distance	Average Daily Mileage	Calculated Time - Rounded (days)	Total Mileage	ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Clear & Grub																
Dump Truck (5)	42	24	1,008	14	14,112	0.66	19.92	2.98	0.51	0.35	0.00	0.14	0.02	0.00	0.00	24.01
Haul Unsuitable Material																
DumpTruck (10)	5	24	130	5	648	0.08	2.56	0.38	0.07	0.05	0.00	0.01	0.00	0.00	0.00	1.10
Utility Road Surface (Agg. Base)																
Dump Truck (7)	33	24	794	20	15,888	0.52	15.70	2.35	0.40	0.28	0.01	0.16	0.02	0.00	0.00	27.03
Indirect Support																
Dump Truck (1)	2	24	48	312	14,976	0.03	0.95	0.14	0.02	0.02	0.00	0.15	0.02	0.00	0.00	25.48
Total			**1,980**		**45,624**	**1.29**	**39.14**	**5.85**	**1.01**	**0.69**	**0.01**	**0.45**	**0.07**	**0.01**	**0.01**	**77.62**

Note: Haul distance assumes that materials from the site will be hauled off and disposed of at the Mira Mar landfill located approximately 24 miles roundtrip from the site in San Diego

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
	Total Trips	Distance	Average Daily Mileage	Total Mileage		ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (Metric Tons)
Worker Trips	120	16.8	2,016	628,992		0.23	1.89	4.49	0.29	0.16	0.04	0.29	0.70	0.05	0.03	215.04

Note: Assumes a total of 40 workers per day and 20 visitors per day, consistent with the traffic report for the proposed project.

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
Total						ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (Metric Tons)
						25.60	**297.25**	**103.28**	**9.63**	**8.52**	**3.40**	**39.57**	**14.29**	**1.24**	**1.12**	**6,102.27**

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Number of Construction Days	312
Number of Pump Construction Days	390

Alternative 1B - Construction - Phase 2

Off-Road Construction Equipment

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
Equipment Type	Equipment Category	Number	Usage Factor (hrs/day)	Power Rating (hp)	Calculated Time - Rounded (days)	ROG	NOX	CO	PM10	PM2.5	ROG	NOX	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Clear & Grub																
Bulldozer	Rubber Tired Dozers Composite	2	10	300	168	2.96	24.49	8.45	1.02	0.94	0.25	2.06	0.71	0.09	0.08	188.37
Front-end Loaders	Rubber Tired Loaders Composite	2	10	250	168	1.50	13.25	4.61	0.45	0.42	0.13	1.11	0.39	0.04	0.03	152.81
Off-Site Dredge to Beneficial Re-Use Areas																
Booster Pump	Pumps Composite	2	20	750	210	7.70	92.54	30.70	2.73	2.51	0.81	9.72	3.22	0.29	0.26	1,461.48
Nesting Site/Transitional Areas																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	3	10	290	12	2.18	18.18	7.17	0.59	0.54	0.01	0.11	0.04	0.00	0.00	18.87
Bulldozer	Rubber Tired Dozers Composite	2	10	300	12	2.96	24.49	8.45	1.02	0.94	0.02	0.15	0.05	0.01	0.01	13.46
Off-road Hauler	Off-Highway Trucks Composite	3	10	725	12	6.43	47.80	19.39	1.68	1.54	0.04	0.29	0.12	0.01	0.01	48.55
Install Internal Revetments/Shore Protection																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	2	10	290	39	1.45	12.12	4.78	0.39	0.36	0.03	0.24	0.09	0.01	0.01	40.88
Front-end Loaders	Rubber Tired Loaders Composite	2	10	250	39	1.50	13.25	4.61	0.45	0.42	0.03	0.26	0.09	0.01	0.01	35.47
Indirect Support																
Front-end Loaders	Rubber Tired Loaders Composite	1	6	250	168	0.45	3.98	1.38	0.14	0.12	0.04	0.33	0.12	0.01	0.01	45.84
Motor Grader	Graders Composite	1	6	150	168	0.52	3.83	2.94	0.21	0.19	0.04	0.32	0.25	0.02	0.02	38.16
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	1	6	290	168	0.44	3.64	1.43	0.12	0.11	0.04	0.31	0.12	0.01	0.01	52.84
Water Truck	Off-Highway Trucks	1	6	175	168	0.51	3.46	3.04	0.19	0.18	0.04	0.29	0.26	0.02	0.01	38.51
Total						**28.58**	**261.02**	**96.95**	**8.99**	**8.27**	**1.47**	**15.18**	**5.45**	**0.50**	**0.46**	**2,135.25**

On Road Construction Emissions

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
	Trips Per Day	Distance	Average Daily Mileage	Calculated Time - Rounded (days)	Total Mileage	ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Clear & Grub																
Dump Truck (7)	42	24	1,008	168	169,344	0.66	19.92	2.98	0.51	0.35	0.06	1.67	0.25	0.04	0.03	288.11
Install Internal Revetments/Shore Protection																
Dump Truck (13)	45	24	1,073	39	41,839	0.70	21.20	3.17	0.55	0.37	0.01	0.41	0.06	0.01	0.01	71.18
Indirect Support																
Dump Truck	2	24	48	168	8,064	0.03	0.95	0.14	0.02	0.02	0.00	0.08	0.01	0.00	0.00	13.72
Total			**1,008**		**169,344**	**1.39**	**42.08**	**6.29**	**1.08**	**0.74**	**0.07**	**2.17**	**0.32**	**0.06**	**0.04**	**373.01**

Notes: Install Internal Revetments/Shore Protection dump truck trips assumes 2.1194 tons of stone in 1 cy. Number in () after equipment name represents the number of equipment.
Haul distance assumes that materials from the site will be hauled off and disposed of at the Mira Mar landfill located approximately 24 miles roundtrip from the site in San Diego

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
	Total Trips	Distance	Average Daily Mileage	Total Mileage		ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Worker Trips	120	16.8	2,016	338,688		0.23	1.89	4.49	0.29	0.16	0.02	0.16	0.38	0.02	0.01	115.79

Note: Assumes a total of 40 workers per day and 20 visitors per day, consistent with the traffic report for the proposed project.

					Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
Total					ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
					30.19	304.98	107.73	10.37	9.18	1.56	17.50	6.15	0.58	0.51	2,624.05

Global Warming Potentia

Gas	Atmospheric Lifetime (years	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Number of Construction Days	168
Number of Pump Construction Days	210

Alternative 1B - Construction - Phase 3

Off-Road Construction Equipment

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
Equipment Type	Equipment Category	Number	Usage Factor (hrs/day)	Power Rating (hp)	Calculated Time - Rounded (days)	ROG	NOX	CO	PM10	PM2.5	ROG	NOX	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Clear & Grub																
Bulldozer	Rubber Tired Dozers Composite	2	10	300	168	2.96	24.49	8.45	1.02	0.94	0.25	2.06	0.71	0.09	0.08	188.37
Front-end Loaders	Rubber Tired Loaders Composite	2	10	250	168	1.50	13.25	4.61	0.45	0.42	0.13	1.11	0.39	0.04	0.03	152.81
Off-Site Dredge to Beneficial Re-Use Areas																
Booster Pump	Pumps Composite	2	20	750	210	7.70	92.54	30.70	2.73	2.51	0.81	9.72	3.22	0.29	0.26	1,462.81
Nesting Site/Transitional Areas																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	3	10	290	12	2.18	18.18	7.17	0.59	0.54	0.01	0.11	0.04	0.00	0.00	18.87
Bulldozer	Rubber Tired Dozers Composite	2	10	300	12	2.96	24.49	8.45	1.02	0.94	0.02	0.15	0.05	0.01	0.01	13.46
Off-road Hauler	Off-Highway Trucks Composite	3	10	725	12	6.43	47.80	19.39	1.68	1.54	0.04	0.29	0.12	0.01	0.01	48.55
Install Internal Revetments/Shore Protection																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	2	10	290	39	1.45	12.12	4.78	0.39	0.36	0.03	0.24	0.09	0.01	0.01	40.88
Front-end Loaders	Rubber Tired Loaders Composite	2	10	250	39	1.50	13.25	4.61	0.45	0.42	0.03	0.26	0.09	0.01	0.01	35.47
Indirect Support																
Front-end Loaders	Rubber Tired Loaders Composite	1	6	250	168	0.45	3.98	1.38	0.14	0.12	0.04	0.33	0.12	0.01	0.01	45.84
Motor Grader	Graders Composite	1	6	150	168	0.52	3.83	2.94	0.21	0.19	0.04	0.32	0.25	0.02	0.02	38.16
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	1	6	290	168	0.44	3.64	1.43	0.12	0.11	0.04	0.31	0.12	0.01	0.01	52.84
Water Truck	Off-Highway Trucks	1	6	175	168	0.51	3.46	3.04	0.19	0.18	0.04	0.29	0.26	0.02	0.01	38.51
Total						**28.58**	**261.02**	**96.95**	**8.99**	**8.27**	**1.47**	**15.18**	**5.45**	**0.50**	**0.46**	**2,136.57**

On Road Construction Emissions

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
	Trips Per Day	Distance	Average Daily Mileage	Calculated Time - Rounded (days)	Total Mileage	ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Clear & Grub																
Dump Truck (7)	42	24	1,008	17	17,136	0.66	19.92	2.98	0.51	0.35	0.01	0.17	0.03	0.00	0.00	29.15
Install Internal Revetments/Shore Protection																
Dump Truck (13)	45	24	1,073	39	41,839	0.70	21.20	3.17	0.55	0.37	0.01	0.41	0.06	0.01	0.01	71.18
Indirect Support																
Dump Truck	2	24	48	168	8,064	0.03	0.95	0.14	0.02	0.02	0.00	0.08	0.01	0.00	0.00	13.72
Total			**1,008**		**67,039**	**1.39**	**42.08**	**6.29**	**1.08**	**0.74**	**0.02**	**0.66**	**0.10**	**0.02**	**0.01**	**114.06**

Notes: Install Internal Revetments/Shore Protection dump truck trips assumes 2.1194 tons of stone in 1 cy. Number in () after equipment name represents the number of equipment.

Haul distance assumes that materials from the site will be hauled off and disposed of at the Mira Mar landfill located approximately 24 miles roundtrip from the site in San Diego

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
	Total Trips	Distance	Average Daily Mileage	Total Mileage		ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Worker Trips	120	16.8	2,016	338,688		0.23	1.89	4.49	0.29	0.16	0.02	0.16	0.38	0.02	0.01	115.79

Note: Assumes a total of 40 workers per day and 20 visitors per day, consistent with the traffic report for the proposed project.

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
Total						ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
						30.19	304.98	107.73	10.37	9.18	1.51	16.00	5.93	0.54	0.49	2,366.42

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Number of Construction Days	168
Number of Pump Construction Days	210

Alternative 1B - Construction - Phase 4

Off-Road Construction Equipment

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
Equipment Type	Equipment Category	Number	Usage Factor (hrs/day)	Power Rating (hp)	Calculated Time - Rounded (days)	ROG	NOX	CO	PM10	PM2.5	ROG	NOX	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Clear & Grub																
Bulldozer	Rubber Tired Dozers Composite	2	10	300	120	2.96	24.49	8.45	1.02	0.94	0.18	1.47	0.51	0.06	0.06	134.25
Front-end Loaders	Rubber Tired Loaders Composite	2	10	250	120	1.50	13.25	4.61	0.45	0.42	0.09	0.80	0.28	0.03	0.02	109.00
Off-Site Dredge to Beneficial Re-Use Areas																
Booster Pump	Pumps Composite	2	20	750	150	7.70	92.54	30.70	2.73	2.51	0.58	6.94	2.30	0.20	0.19	1,043.87
Install Internal Revetments/Shore Protection																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	2	10	290	10	1.45	12.12	4.78	0.39	0.36	0.01	0.06	0.02	0.00	0.00	10.48
Front-end Loaders	Rubber Tired Loaders Composite	2	10	250	10	1.50	13.25	4.61	0.45	0.42	0.01	0.07	0.02	0.00	0.00	9.10
Scour Protection																
Crane	Cranes Composite	1	10	250	10	0.62	5.55	1.82	0.19	0.18	0.00	0.03	0.01	0.00	0.00	3.42
Excavation & Disposal (Beach Fill)																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	3	10	290	10	2.18	18.18	7.17	0.59	0.54	0.01	0.09	0.04	0.00	0.00	15.72
Bulldozer	Rubber Tired Dozers Composite	2	10	300	10	2.96	24.49	8.45	1.02	0.94	0.01	0.12	0.04	0.01	0.00	11.21
Motor Grader	Graders Composite	1	10	300	2	0.87	6.39	4.90	0.35	0.32	0.00	0.01	0.00	0.00	0.00	0.76
Cobble Blocking Features																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	1	10	290	21	0.73	6.06	2.39	0.20	0.18	0.01	0.06	0.03	0.00	0.00	11.01
Front-end Loaders	Rubber Tired Loaders Composite	1	10	250	21	0.75	6.63	2.31	0.23	0.21	0.01	0.07	0.02	0.00	0.00	9.55
Indirect Support																
Front-end Loaders	Rubber Tired Loaders Composite	1	6	250	120	0.45	3.98	1.38	0.14	0.12	0.03	0.24	0.08	0.01	0.01	32.70
Motor Grader	Graders Composite	1	6	150	120	0.52	3.83	2.94	0.21	0.19	0.03	0.23	0.18	0.01	0.01	27.20
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	1	6	290	120	0.44	3.64	1.43	0.12	0.11	0.03	0.22	0.09	0.01	0.01	37.69
Water Truck	Off-Highway Trucks	1	6	175	120	0.51	3.46	3.04	0.19	0.18	0.03	0.21	0.18	0.01	0.01	27.46
Total						**25.12**	**237.85**	**88.99**	**8.28**	**7.62**	**1.02**	**10.61**	**3.80**	**0.35**	**0.32**	**1,483.42**

On Road Construction Emissions

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
	Trips Per Day	Distance	Average Daily Mileage	Calculated Time - Rounded (days)	Total Mileage	ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Excavation & Disposal (Beach Fill)																
Dump Truck (12)	42	1	42	10	417	0.03	0.82	0.12	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.71
Cobble Blocking Features																
Dump Truck (6)	21	24	494	21	10,382	0.32	9.77	1.46	0.25	0.17	0.00	0.10	0.02	0.00	0.00	17.66
Indirect Support																
Dump Truck	2	24	48	120	5,760	0.03	0.95	0.14	0.02	0.02	0.00	0.06	0.01	0.00	0.00	9.80
Total			**584**		**16,559**	**0.38**	**11.55**	**1.73**	**0.30**	**0.20**	**0.01**	**0.16**	**0.02**	**0.00**	**0.00**	**28.17**

Notes: Install Internal Revetments/Shore Protection dump truck trips assumes 2.1194 tons of stone in 1 cy. Number in () after equipment name represents the number of equipment.
Haul distance assumes that materials from the site will be hauled off and disposed of at the Mira Mar landfill located approximately 24 miles roundtrip from the site in San Diego

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
	Total Trips	Distance	Average Daily Mileage	Total Mileage		ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Worker Trips	120	16.8	2,016	241,920		0.23	1.89	4.49	0.29	0.16	0.01	0.11	0.27	0.02	0.01	82.71

Note: Assumes a total of 40 workers per day and 20 visitors per day, consistent with the traffic report for the proposed project.

					Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
Total					ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
					25.72	251.28	95.20	8.87	7.99	1.04	10.88	4.10	0.37	0.34	1,594.30

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Number of Construction Days	120
Number of Pump Construction Days	150

Alternative 1B - Dredge Emissions - Phase 1

Assumptions

Main Generator Engine	2560	bhp
	1909.0	kW
Aux Generator Engines	750	bhp
	559.3	kW
Number	1.0	

			Emissions (pounds per day)					Emissions (tons per phase)					Emissions (metric tons per phase)
Activity	Number of Construction Days	Time (hours per day)	ROG	NOx	CO	PM10	PM2.5	ROG	NOx	CO	PM10	PM2.5	CO2e*
Dredge	390	20	48.23	447.76	199.07	16.07	14.78	9.40	87.31	38.82	3.13	2.88	5,949.44

*To account for N20 and CH4 emissions, an extra 5% was added to the CO2 emissions.

Main Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
3300 hp	0.70	7.30	2.92	0.29	0.27	652	184.16

Note: CO2 emission factor in g/kWh

Source: ARB Harborcraft Emission Inventory Database

Auxiliary Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
1000 hp	0.84	6.82	3.42	0.26	0.24	652	184.16

Note: CO2 emission factor in g/kWh

Source: ARB Harborcraft Emission Inventory Database

CO2 emissions factor from Port of Long Beach. 2011 Emissions Inventory. Available at http://www.polb.com/environment/air/emissions.asp.

Load Factor

Engine	Load factor
Propulsion	0.45
Auxiliary	0.45

Source: ARB. Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

Table II-4 Fuel Correction Factor

Calendar Years	Horsepower Range	Model Years	NOx	PM
1994-2006	<25	Pre-1995	0.930	0.750
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.822
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
2007+	<25	Pre-1995	0.930	0.720
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.800
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
	All	2011+	0.948	0.852

Source: Off-road Exhaust Emissions Inventory Fuel Correction Factors *(2)*

Calendar Years	Horsepower Range	Model Years	NOx	PM
2007+	All	2011+	0.948	0.852

Source: ARB, Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

The basic equation for the estimating emissions from a commercial harbor craft engine is:

$$E = EF_0 \times F \times (1 + D \times \frac{A}{UL}) \times HP \times LF \times Hr$$

Where:

E is the amount of emissions of a pollutant (ROG, CO, NOx, or PM) emitted during one period; [7]
EF₀ is the model year, horsepower and engine use (propulsion or auxiliary) specific zero hour emission factor (when engine is new);
F is the fuel correction factor which accounts for emission reduction benefits from burning cleaner fuel;
D is the horsepower and pollutant specific engine deterioration factor, which is the percentage increase of emission factors at the end of the useful life of the engine;
A is the age of the engine when the emissions are estimated;
UL is the vessel type and engine use specific engine useful life;
HP is rated horsepower of the engine;
LF is the vessel type and engine use specific engine load factor;
Hr is the number of annual operating hours of the engine.

Alternative 1B - Electric Dredge Emissions - Phase 1

Assumptions

Main Generator Engine	2560	bhp
	1909.0	kW
Aux Generator Engines	750	bhp
	559.3	kW
Total kW	2468.2	

Emissions (metric tons per phase)

Activity	Number of Construction Days	Time (hours per day)	Daily Energy Consumption (kWh)	CO2e*
Dredge	390	20	49,364.68	6,391.91

	Emission Factors (lb/MWh)
CO_2	720.490
N_2O	0.029
CH_4	0.010

Source: Climate Action Registry, 2012. SDG&E 2009 Annual Entity Emissions: Electric Power Generation/Electric Utility Sector.

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Alternative 1B - Dredge Emissions - Phase 2

Assumptions

Main Generator Engine	2560 bhp
	1909.0 kW
Aux Generator Engines	750 bhp
	559.3 kW
Number	1.0

			Emissions (pounds per day)					Emissions (tons per phase)					Emissions (metric tons per phase)
Activity	Number of Construction Days	Time (hours per day)	ROG	NOx	CO	PM10	PM2.5	ROG	NOx	CO	PM10	PM2.5	CO2e*
Dredge	210	20	48.23	447.76	199.07	16.07	14.78	5.06	47.01	20.90	1.69	1.55	3,203.54

*To account for N20 and CH4 emissions, an extra 5% was added to the CO2 emissions.

Main Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
3300 hp	0.70	7.30	2.92	0.29	0.27	652	184.16

Note: CO2 emission factor in g/kWh

Source: ARB Harborcraft Emission Inventory Database

Auxiliary Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
1000 hp	0.84	6.82	3.42	0.26	0.24	652	184.16

Note: CO2 emission factor in g/kWh

Source: ARB Harborcraft Emission Inventory Database

CO2 emissions factor from Port of Long Beach. 2011 Emissions Inventory. Available at http://www.polb.com/environment/air/emissions.asp.

Load Factor

Engine	Load factor
Propulsion	0.45
Auxiliary	0.45

Source: ARB. Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

Table II-4 Fuel Correction Factor

Calendar Years	Horsepower Range	Model Years	NOx	PM
1994-2006	<25	Pre-1995	0.930	0.750
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.940	0.822
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
2007+	<25	Pre-1995	0.930	0.720
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.800
	25-50	1999-2010		
	51 100	1998 2010		
	101-175	1997-2010		
	176+	1996-2010		
	All	2011+	0.948	0.852

Source: Off-road Exhaust Emissions Inventory Fuel Correction Factors *(2)*

Calendar Years	Horsepower Range	Model Years	NOx	PM
2007+	All	2011+	0.948	0.852

Source: ARB, Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

The basic equation for the estimating emissions from a commercial harbor craft engine is:

$$E = EF_0 \times F \times (1 + D \times \frac{A}{UL}) \times HP \times LF \times Hr$$

Where:

E is the amount of emissions of a pollutant (ROG, CO, NOx, or PM) emitted during one period: [7]
EF₀ is the model year, horsepower and engine use (propulsion or auxiliary) specific zero hour emission factor (when engine is new);
F is the fuel correction factor which accounts for emission reduction benefits from burning cleaner fuel;
D is the horsepower and pollutant specific engine deterioration factor, which is the percentage increase of emission factors at the end of the useful life of the engine;
A is the age of the engine when the emissions are estimated;
UL is the vessel type and engine use specific engine useful life;
HP is rated horsepower of the engine;
LF is the vessel type and engine use specific engine load factor;
Hr is the number of annual operating hours of the engine.

Alternative 1B - Electric Dredge Emissions - Phase 2

Assumptions

Main Generator Engine	2560	bhp
	1909.0	kW
Aux Generator Engines	750	bhp
	559.3	kW
Total kW	2468.2	

				Emissions (metric tons per phase)
Activity	**Number of Construction Days**	**Time (hours per day)**	**Daily Energy Consumption (kWh)**	**CO2e***
Dredge	210	20	49,364.68	3,441.80

	Emission Factors (lb/MWh)
CO_2	720.490
N_2O	0.029
CH_4	0.010

Source: Climate Action Registry, 2012. SDG&E 2009 Annual Entity Emissions: Electric Power Generation/Electric Utility Sector.

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Alternative 1B - Dredge Emissions - Phase 3

Assumptions

Main Generator Engine	2560 bhp
	1909.0 kW
Aux Generator Engines	750 bhp
	559.3 kW
Number	1.0

			Emissions (pounds per day)					Emissions (tons per phase)					Emissions (metric tons per phase)
Activity	Number of Construction Days	Time (hours per day)	ROG	NOx	CO	PM10	PM2.5	ROG	NOx	CO	PM10	PM2.5	CO2e*
Dredge	210	20	48.23	447.76	199.07	16.07	14.78	5.06	47.01	20.90	1.69	1.55	3,203.54

*To account for N20 and CH4 emissions, an extra 5% was added to the CO2 emissions.

Main Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
3300 hp	0.70	7.30	2.92	0.29	0.27	652	184.16

Note: CO2 emission factor in g/kWh

Source: ARB Harborcraft Emission Inventory Database

Auxiliary Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
1000 hp	0.84	6.82	3.42	0.26	0.24	652	184.16

Note: CO2 emission factor in g/kWh

Source: ARB Harborcraft Emission Inventory Database

CO2 emissions factor from Port of Long Beach. 2011 Emissions Inventory. Available at http://www.polb.com/environment/air/emissions.asp.

Load Factor

Engine	Load factor
Propulsion	0.45
Auxiliary	0.45

Source: ARB. Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

Table II-4 Fuel Correction Factor

Calendar Years	Horsepower Range	Model Years	NOx	PM
1994-2006	<25	Pre-1995	0.930	0.750
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.940	0.822
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
2007+	<25	Pre-1995	0.930	0.720
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.800
	25-50	1999-2010		
	51 100	1998 2010		
	101-175	1997-2010		
	176+	1996-2010		
	All	2011+	0.948	0.852

Source: Off-road Exhaust Emissions Inventory Fuel Correction Factors *(2)*

Calendar Years	Horsepower Range	Model Years	NOx	PM
2007+	All	2011+	0.948	0.852

Source: ARB, Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

The basic equation for the estimating emissions from a commercial harbor craft engine is:

$$E = EF_0 \times F \times (1 + D \times \frac{A}{UL}) \times HP \times LF \times Hr$$

Where:

E is the amount of emissions of a pollutant (ROG, CO, NOx, or PM) emitted during one period: [7]
EF₀ is the model year, horsepower and engine use (propulsion or auxiliary) specific zero hour emission factor (when engine is new);
F is the fuel correction factor which accounts for emission reduction benefits from burning cleaner fuel;
D is the horsepower and pollutant specific engine deterioration factor, which is the percentage increase of emission factors at the end of the useful life of the engine;
A is the age of the engine when the emissions are estimated;
UL is the vessel type and engine use specific engine useful life;
HP is rated horsepower of the engine;
LF is the vessel type and engine use specific engine load factor;
Hr is the number of annual operating hours of the engine.

Alternative 1B - Electric Dredge Emissions - Phase 3

Assumptions

Main Generator Engine	2560	bhp
	1909.0	kW
Aux Generator Engines	750	bhp
	559.3	kW
Total kW	2468.2	

				Emissions (metric tons per phase)
Activity	**Number of Construction Days**	**Time (hours per day)**	**Daily Energy Consumption (kWh)**	**CO2e***
Dredge	210	20	49,364.68	3,441.80

	Emission Factors (lb/MWh)
CO_2	720.490
N_2O	0.029
CH_4	0.010

Source: Climate Action Registry, 2012. SDG&E 2009 Annual Entity Emissions: Electric Power Generation/Electric Utility Sector.

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Alternative 1B - Dredge Emissions - Phase 4

Assumptions

Main Generator Engine	2560 bhp
	1909.0 kW
Aux Generator Engines	750 bhp
	559.3 kW
Number	1.0

			Emissions (pounds per day)					Emissions (tons per phase)					Emissions (metric tons per phase)
Activity	Number of Construction Days	Time (hours per day)	ROG	NOx	CO	PM10	PM2.5	ROG	NOx	CO	PM10	PM2.5	CO2e*
Dredge	150	20	48.23	447.76	199.07	16.07	14.78	3.62	33.58	14.93	1.20	1.11	2,288.25

*To account for N20 and CH4 emissions, an extra 5% was added to the CO2 emissions.

Main Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
3300 hp	0.70	7.30	2.92	0.29	0.27	652	184.16

Note: CO2 emission factor in g/kWh

Source: ARB Harborcraft Emission Inventory Database

Auxiliary Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
1000 hp	0.84	6.82	3.42	0.26	0.24	652	184.16

Note: CO2 emission factor in g/kWh

Source: ARB Harborcraft Emission Inventory Database

CO2 emissions factor from Port of Long Beach. 2011 Emissions Inventory. Available at http://www.polb.com/environment/air/emissions.asp.

Load Factor

Engine	Load factor
Propulsion	0.45
Auxiliary	0.45

Source: ARB. Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

Table II-4 Fuel Correction Factor

Calendar Years	Horsepower Range	Model Years	NOx	PM
1994-2006	<25	Pre-1995	0.930	0.750
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.940	0.822
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
2007+	<25	Pre-1995	0.930	0.720
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.800
	25-50	1999-2010		
	51 100	1998 2010		
	101-175	1997-2010		
	176+	1996-2010		
	All	2011+	0.948	0.852

Source: Off-road Exhaust Emissions Inventory Fuel Correction Factors *(2)*

Calendar Years	Horsepower Range	Model Years	NOx	PM
2007+	All	2011+	0.948	0.852

Source: ARB, Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

The basic equation for the estimating emissions from a commercial harbor craft engine is:

$$E = EF_0 \times F \times (1 + D \times \frac{A}{UL}) \times HP \times LF \times Hr$$

Where:

E is the amount of emissions of a pollutant (ROG, CO, NOx, or PM) emitted during one period: [7]
EF₀ is the model year, horsepower and engine use (propulsion or auxiliary) specific zero hour emission factor (when engine is new);
F is the fuel correction factor which accounts for emission reduction benefits from burning cleaner fuel;
D is the horsepower and pollutant specific engine deterioration factor, which is the percentage increase of emission factors at the end of the useful life of the engine;
A is the age of the engine when the emissions are estimated;
UL is the vessel type and engine use specific engine useful life;
HP is rated horsepower of the engine;
LF is the vessel type and engine use specific engine load factor;
Hr is the number of annual operating hours of the engine.

Alternative 1B - Electric Dredge Emissions - Phase 4

Assumptions

Main Generator Engine	2560	bhp
	1909.0	kW
Aux Generator Engines	750	bhp
	559.3	kW
Total kW	2468.2	

				Emissions (metric tons per phase)
Activity	**Number of Construction Days**	**Time (hours per day)**	**Daily Energy Consumption (kWh)**	**CO2e***
Dredge	150	20	49,364.68	2,458.43

	Emission Factors (lb/MWh)
CO_2	720.490
N_2O	0.029
CH_4	0.010

Source: Climate Action Registry, 2012. SDG&E 2009 Annual Entity Emissions: Electric Power Generation/Electric Utility Sector.

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Alternative 1B - Material Disposal

Assumptions

Main Generator Engine	5000 bhp
	3728.5 kW
Aux Generator Engines	3000 bhp
	2237.1 kW
Number	1.0

			Emissions (pounds per day)							Emissions (tons per phase)						Emissions (metric tons per phase)
Activity	Number of Construction Days	Time (hours per day)	ROG	NOx	CO	PM10	PM2.5	CO2e*	ROG	NOx	CO	PM10	PM2.5	CO2e*
Leucadia/Torrey Pines	72.40	2.12	12.71	115.59	52.36	4.28	3.94	8603.89	0.46	4.18	1.90	0.15	0.14	283.43
Moonlight Beach	21.00	0.77	4.62	42.03	19.04	1.56	1.43	3128.69	0.05	0.44	0.20	0.02	0.02	29.89
Solana Beach	29.20	0.39	2.31	21.02	9.52	0.78	0.72	1564.34	0.03	0.31	0.14	0.01	0.01	20.78
Total	122.60	3.28	12.71	115.59	52.36	4.28	3.94	8603.89	0.54	4.93	2.23	0.18	0.17	334.11

Notes: Assumes 1 tug round trip per day. Each tug would transport 2 barges per trip. Material disposal would only occur during Phase 1 of the proposed project or alternative.
*To account for N20 and CH4 emissions, an extra 5% was added to the CO2 emissions.

Main Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
5000 hp	0.70	7.42	2.92	0.31	0.29	652	184.16

Note: CO2 emission factor in g/kWh
Source: ARB Harborcraft Emission Inventory Database
CO2 emissions factor from Port of Long Beach. 2011 Emissions Inventory. Available at http://www.polb.com/environment/air/emissions.asp.

Auxiliary Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
3300 hp	0.84	6.93	3.42	0.27	0.25	652	184.16

Note: CO2 emission factor in g/kWh
Source: ARB Harborcraft Emission Inventory Database
CO2 emissions factor from Port of Long Beach. 2011 Emissions Inventory. Available at http://www.polb.com/environment/air/emissions.asp.

Load Factor

Engine	Load factor
Propulsion	0.45
Auxiliary	0.45

Source: ARB. Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

Table II-4 Fuel Correction Factor

Calendar Years	Horsepower Range	Model Years	NOx	PM
1994-2006	<25	Pre-1995	0.930	0.750
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.822
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
2007+	<25	Pre-1995	0.930	0.720
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.800
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
	All	2011+	0.948	0.852

Source: Off-road Exhaust Emissions Inventory Fuel Correction Factors *(2)*

Calendar Years	Horsepower Range	Model Years	NOx	PM
2007+	All	2011+	0.948	0.852

Source: ARB, Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

The basic equation for the estimating emissions from a commercial harbor craft engine is:

$$E = EF_0 \times F \times (1 + D \times \frac{A}{UL}) \times HP \times LF \times Hr$$

Where:

E is the amount of emissions of a pollutant (ROG, CO, NOx, or PM) emitted during one period; [7]
EF$_0$ is the model year, horsepower and engine use (propulsion or auxiliary) specific zero hour emission factor (when engine is new);
F is the fuel correction factor which accounts for emission reduction benefits from burning cleaner fuel;
D is the horsepower and pollutant specific engine deterioration factor, which is the percentage increase of emission factors at the end of the useful life of the engine;
A is the age of the engine when the emissions are estimated;
UL is the vessel type and engine use specific engine useful life;
HP is rated horsepower of the engine;
LF is the vessel type and engine use specific engine load factor;
Hr is the number of annual operating hours of the engine.

Alternative 1B - Operations

Off-Road Construction Equipment

					Emissions Summary (lbs/day)					Emissions Summary (tons/year)					
Equipment Type	**Equipment Category**	**Number**	**Usage Factor**	**Unit**	**ROG**	**NOX**	**CO**	**PM10**	**PM2.5**	**ROG**	**NOX**	**CO**	**PM10**	**PM2.5**	**Total GHG Emissions (Metric Tons)**
Rubber Tired Dozer	Rubber Tired Dozers Composite	1	10	hrs/day	1.42	10.57	5.36	0.42	0.39	0.02	0.16	0.08	0.01	0.01	
Backhoe	Tractors/Loaders/Backhoes Composite	1	10	hrs/day	0.29	1.84	2.42	0.09	0.08	0.00	0.03	0.04	0.00	0.00	
Off-Highway Trucks	Off-Highway Trucks Composite	3	10	hrs/day	2.90	16.70	11.08	0.56	0.52	0.04	0.25	0.17	0.01	0.01	
					4.61	29.10	18.87	1.08	0.99	0.07	0.44	0.28	0.02	0.01	99.45

On Road Construction Emissions

					Emissions Summary (lbs/day)					Emissions Summary (tons/year)					
	Trips Per Day	**Distance**	**Average Daily Mileage**	**Total Mileage**	**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**Total GHG Emissions (Metric Tons)**
Heavy-Duty Trucks	2	12	24	720	0.01	0.22	0.05	0.01	0.01	0.000	0.003	0.001	0.000	0.000	1
Total			**24**	**720**	**0.01**	**0.22**	**0.05**	**0.01**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.12**

Note: Assumes 1 miscellaneous round truck trip per day.

					Emissions Summary (lbs/day)					Emissions Summary (tons/year)					
	Total Trips	**Distance**	**Average Daily Mileage**	**Total Mileage**	**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**Total GHG Emissions (Metric Tons)**
Worker Trips	40	16.8	672	20,160	0.04	0.93	0.42	0.08	0.04	0.00	0.01	0.01	0.00	0.00	5.77

Note: Assumes a total of 20 workers per day.

					Emissions Summary (lbs/day)					Emissions Summary (tons/year)					
Total					**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**Total GHG Emissions (Metric Tons)**
					4.66	30.25	19.34	1.17	1.04	0.07	0.45	0.29	0.02	0.02	106.34

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Number of Construction Days 30

Alt 2A - Emissions Summary
Construction

	Total Daily Emissions (pounds/day)				
	ROG	**NOX**	**CO**	**PM10**	**PM2.5**
Phase 1					
Mobilization/Demobilization/Site Preparation	8	70	39	3	3
Construction Equipment/On-Road Vehicles	39	457	155	56	16
Dredging	48	448	199	16	15
Material Disposal	13	116	52	4	4
Phase 1 - Maximum Daily Emissions	**100**	**1,020**	**407**	**77**	**35**
Phase 2					
Construction Equipment/On-Road Vehicles	42	453	154	60	16
Dredging	48	448	199	16	15
Phase 2 - Maximum Daily Emissions	**90**	**900**	**353**	**76**	**31**
Phase 3					
Construction Equipment/On-Road Vehicles	36	386	134	57	14
Dredging	48	448	199	16	15
Phase 3 - Maximum Daily Annual Emissions	**85**	**833**	**333**	**73**	**29**
Phase 4					
Mobilization/Demobilization/Site Preparation	2	26	14	1	1
Construction Equipment/On-Road Vehicles	26	253	98	40	10
Dredging	48	448	199	16	15
Phase 4 - Maximum Daily Emissions	**77**	**727**	**311**	**58**	**25**

Operations

	Total Daily Emissions (pounds/day)				
	ROG	**NOX**	**CO**	**PM10**	**PM2.5**
Dry Construction Emissions	9.29	76.84	43.49	2.65	2.37
Wet Construction Emissions	38.32	301.20	213.93	10.43	9.60
Total Operational Emissions	**47.61**	**378.04**	**257.42**	**13.09**	**11.97**

Alt 2A - Mitigated Emissions Summary
Construction

	Total Daily Emissions (pounds/day)				
	ROG	**NOX**	**CO**	**PM10**	**PM2.5**
Phase 1					
Construction Equipment	22	214	134	53	14
On-Road Vehicles	4	112	21	3	2
Dredging	48	448	199	16	15
Material Disposal	7	64	52	4	4
Phase 1 - Maximum Daily Emissions	**81**	**837**	**407**	**77**	**35**

Alt 2A - Annual Emissions Summary
Construction

	Annual Emissions (tons)					Annual GHG Emissions (metric tons)
	ROG	NOX	CO	PM10	PM2.5	CO2e
2016						
Mobilization/Demobilization/Site Preparation	0.15	1.46	0.79	0.07	0.06	251
Construction Equipment/On-Road Vehicles	1.46	17.12	6.11	3.09	0.62	2,632
Dredging	3.77	35.02	15.57	1.26	1.16	2,386
Material Disposal	0.22	1.98	0.90	0.07	0.07	134
Total Annual Emissions	**5.60**	**55.58**	**23.36**	**4.49**	**1.90**	**5,403**
2017						
Construction Equipment/On-Road Vehicles	2.68	31.40	11.13	5.85	1.15	4,806
Dredging	7.07	65.67	29.19	2.36	2.17	4,474
Material Disposal	0.32	2.95	1.34	0.11	0.10	200
Total Annual Emissions	**10.08**	**100.02**	**41.66**	**8.32**	**3.42**	**9,480**
2018						
Construction Equipment/On-Road Vehicles	2.27	26.88	9.22	6.14	1.04	4,127
Dredging	7.25	67.35	29.94	2.42	2.22	4,589
Total Annual Emissions	**9.52**	**94.24**	**39.17**	**8.56**	**3.27**	**8,717**
2019						
Mobilization/Demobilization	0.09	0.94	0.49	0.04	0.03	173
Construction Equipment/On-Road Vehicles	1.19	13.68	5.28	3.38	0.56	2,209
Dredging	5.05	46.89	20.85	1.68	1.55	3,195
Total Annual Emissions	**6.33**	**61.50**	**26.61**	**5.11**	**2.14**	**5,577**

Operations

	Annual Emissions (tons)					Annual GHG Emissions (metric tons)
	ROG	NOX	CO	PM10	PM2.5	CO2e
2020						
Construction Equipment/On-Road Vehicles	0.64	5.38	3.02	0.18	0.16	1,398
Dredge	2.87	22.59	16.04	0.78	0.72	2,288
Total	**3.51**	**27.97**	**19.07**	**0.97**	**0.88**	**3,686**

Alt 2A - Annual Emissions Summary
Electric Dredge

	Annual GHG Emissions (metric tons)
	CO2e
2016	
Mobilization/Demobilization/Site Preparation	251
Construction Equipment/On-Road Vehicles	2,632
Dredging	2,564
Material Disposal	134
Total Annual Emissions	**5,580**
2017	
Construction Equipment/On-Road Vehicles	4,806
Dredging	4,807
Material Disposal	200
Total Annual Emissions	**9,813**
2018	
Construction Equipment/On-Road Vehicles	4,127
Dredging	4,931
Total Annual Emissions	**9,058**
2019	
Mobilization/Demobilization	173
Construction Equipment/On-Road Vehicles	2,209
Dredging	3,433
Total Annual Emissions	**5,815**

Operations

	Annual GHG Emissions (metric tons)
	CO2e
2020	
Construction Equipment/On-Road Vehicles	1,398
Dredge	2,458
Total	**3,856**

Alternative 2A - Construction - Phase 1

Off-Road Construction Equipmen

Equipment Type	Equipment Category	Number	Usage Factor (hrs/day)	Power Rating (hp)	Calculated Time - Rounded (days)	Emissions Summary (lbs/day) ROG	NOX	CO	PM10	PM2.5	Emissions Summary (tons per phase) ROG	NOX	CO	PM10	PM2.5	Total GHG Emissions (Metric Tons)
Clear & Grub																
Bulldozer	Rubber Tired Dozers Composite	2	10	300	14	2.96	24.49	8.45	1.02	0.94	0.02	0.17	0.06	0.01	0.01	15.70
Front-end Loaders	Rubber Tired Loaders Composite	2	10	250	14	1.50	13.25	4.61	0.45	0.42	0.01	0.09	0.03	0.00	0.00	12.73
Demolition of Hwy 101																
Bulldozer	Rubber Tired Dozers Composite	1	10	300	13	1.48	12.24	4.22	0.51	0.47	0.01	0.08	0.03	0.00	0.00	7.29
Front-end Loaders	Rubber Tired Loaders Composite	2	10	250	13	1.50	13.25	4.61	0.45	0.42	0.01	0.09	0.03	0.00	0.00	11.82
Crusher Operation	Crushing/Proc. Equipment Composite	1	10	100	13	0.78	4.94	3.78	0.42	0.39	0.01	0.03	0.02	0.00	0.00	3.30
Off-Site Dredge to Beneficial Re-Use Areas																
Booster Pump	Pumps Composite	4	20	750	390	15.39	185.08	61.40	5.46	5.02	3.00	36.09	11.97	1.06	0.98	5,433.30
Haul Unsuitable Material																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	2	10	290	5	1.45	12.12	4.78	0.39	0.36	0.00	0.03	0.01	0.00	0.00	5.24
Utility Road Surface (Agg. Base)																
Motor Grader	Graders Composite	1	10	150	20	0.87	6.39	4.90	0.35	0.32	0.01	0.06	0.05	0.00	0.00	7.57
Highway 101 Bridge and Approaches																
Drive Piles																
Crawler	Crawler Tractors Composite	1	10	300	30	1.06	9.07	3.09	0.34	0.32	0.02	0.14	0.05	0.01	0.00	15.22
Compressor	Air Compressors Composite	1	10	100	30	0.46	2.90	2.13	0.25	0.23	0.01	0.04	0.03	0.00	0.00	4.31
Install Formwork, Rebar & Misc Items																
Crane	Cranes Composite	1	10	250	72	0.62	5.55	1.82	0.19	0.18	0.02	0.20	0.07	0.01	0.01	24.66
Forklift	Forklifts Composite	1	10	120	72	0.23	1.56	1.44	0.12	0.11	0.01	0.06	0.05	0.00	0.00	6.87
Place Concrete																
Concrete Pump	Pumps Composite	1	6	250	30	0.44	5.33	1.61	0.15	0.14	0.01	0.08	0.02	0.00	0.00	11.06
Excavation & Backfill - Bridge																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	1	2	290	9	0.15	1.21	0.48	0.04	0.04	0.00	0.01	0.00	0.00	0.00	0.94
Front-end Loaders	Rubber Tired Loaders Composite	1	2	250	9	0.15	1.33	0.46	0.05	0.04	0.00	0.01	0.00	0.00	0.00	0.82
Excavation & Backfill - Road																
Front-end Loaders	Rubber Tired Loaders Composite	2	10	250	74	1.50	13.25	4.61	0.45	0.42	0.06	0.49	0.17	0.02	0.02	67.31
Aggregate Base																
Motor Grader	Graders Composite	1	10	150	74	0.87	6.39	4.90	0.35	0.32	0.03	0.24	0.18	0.01	0.01	28.01
Asphalt Concrete																
Asphalt Paver	Pavers Composite	1	10	130	17	0.65	3.94	2.61	0.34	0.31	0.01	0.03	0.02	0.00	0.00	2.83
Roller	Rollers Composite	2	10	130	17	1.15	7.37	5.36	0.61	0.56	0.01	0.06	0.05	0.01	0.00	6.13
Indirect Support																
Front-end Loaders	Rubber Tired Loaders Composite	1	6	250	312	0.45	3.98	1.38	0.14	0.12	0.07	0.62	0.22	0.02	0.02	85.14
Motor Grader	Graders Composite	1	6	150	312	0.52	3.83	2.94	0.21	0.19	0.08	0.60	0.46	0.03	0.03	70.86
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	1	6	290	312	0.44	3.64	1.43	0.12	0.11	0.07	0.57	0.22	0.02	0.02	98.12
Water Truck	Off-Highway Trucks	1	6	175	312	0.51	3.46	3.04	0.19	0.18	0.08	0.54	0.47	0.03	0.03	71.52
Total						**35.12**	**344.56**	**134.07**	**12.61**	**11.60**	**3.53**	**40.32**	**14.22**	**1.25**	**1.15**	**5,990.76**

On Road Construction Emission

	Trips Per Day	Distance (roundtrip)	Average Daily Mileage	Calculated Time - Rounded (days)	Total Mileage	Emissions Summary (lbs/day) ROG	NO_x	CO	PM10	PM2.5	Emissions Summary (tons per phase) ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Clear & Grub																
Dump Truck (5)	42	24	1,008	14	14,112	0.66	19.92	2.98	0.51	0.35	0.00	0.14	0.02	0.00	0.00	24.01
Demolition of Hwy 101																
DumpTruck (2)	63	24	1,500	13	19,500	0.98	29.65	4.43	0.76	0.52	0.01	0.19	0.03	0.00	0.00	33.18
Haul Unsuitable Material																
Dump Truck (10)	5	24	130	5	648	0.08	2.56	0.38	0.07	0.05	0.00	0.01	0.00	0.00	0.00	1.10
Utility Road Surface (Agg. Base)																
Dump Truck (7)	33	24	794	20	15,888	0.52	15.70	2.35	0.40	0.28	0.01	0.16	0.02	0.00	0.00	27.03
Concrete Delivery Trucks																
Concrete Truck (3)	6	24	144	30	4,320	0.09	2.85	0.43	0.07	0.05	0.00	0.04	0.01	0.00	0.00	7.35
Other Delivery Trucks																
Delivery Truck	2	24	48	9	432	0.03	0.95	0.14	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.73
Dump Trucks																
Dump Truck (38)	75	24	1,800	74	133,200	1.17	35.58	5.32	0.91	0.63	0.04	1.32	0.20	0.03	0.02	226.62
Base & Asphalt Trucks																
Dump Truck (3)	5	24	120	74	8,880	0.08	2.37	0.35	0.06	0.04	0.00	0.09	0.01	0.00	0.00	15.11
Indirect Support																
Dump Truck (1)	2	24	48	265	12,720	0.03	0.95	0.14	0.02	0.02	0.00	0.13	0.02	0.00	0.00	21.64
Total			**5,592**	**504**	**209,700**	**3.64**	**110.53**	**16.52**	**2.84**	**1.94**	**0.07**	**2.07**	**0.31**	**0.05**	**0.04**	**356.77**

Notes: Utility Road Surfact (Agg. Base) dump truck trips assumes 2.1194 tons of stone in 1 cy. Number in () after equipment name represents the number of equipment.
Haul distance assumes that materials from the site will be hauled off and disposed of at the Mira Mar landfill located approximately 24 miles roundtrip from the site in San Diego

	Total Trips	Distance	Average Daily Mileage	Total Mileage		Emissions Summary (lbs/day) ROG	NO_x	CO	PM10	PM2.5	Emissions Summary (tons per phase) ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Worker Trips	120	16.8	2,016	628,992		0.23	1.89	4.49	0.29	0.16	0.04	0.29	0.70	0.05	0.03	215.04

Note: Assumes a total of 40 workers per day and 20 visitors per day, consistent with the traffic report for the proposed project.

Total						Emissions Summary (lbs/day) ROG	NO_x	CO	PM10	PM2.5	Emissions Summary (tons per phase) ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
						38.99	456.97	155.08	15.74	13.70	3.64	42.69	15.23	1.35	1.21	6,562.57

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Number of Construction Days	312
Number of Pump Construction Days	390

Alternative 2A - Construction - Phase 2

Off-Road Construction Equipment

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
Equipment Type	Equipment Category	Number	Usage Factor (hrs/day)	Power Rating (hp)	Calculated Time - Rounded (days)	ROG	NOX	CO	PM10	PM2.5	ROG	NOX	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Clear & Grub																
Bulldozer	Rubber Tired Dozers Composite	2	10	300	168	2.96	24.49	8.45	1.02	0.94	0.25	2.06	0.71	0.09	0.08	188.37
Front-end Loaders	Rubber Tired Loaders Composite	2	10	250	168	1.50	13.25	4.61	0.45	0.42	0.13	1.11	0.39	0.04	0.03	152.81
Demolition of Hwy 101																
Bulldozer	Rubber Tired Dozers Composite	1	10	300	13	1.48	12.24	4.22	0.51	0.47	0.01	0.08	0.03	0.00	0.00	7.29
Front-end Loaders	Rubber Tired Loaders Composite	2	10	250	13	1.50	13.25	4.61	0.45	0.42	0.01	0.09	0.03	0.00	0.00	11.82
Crusher Operation	Crushing/Proc. Equipment Composite	1	10	100	13	0.78	4.94	3.78	0.42	0.39	0.01	0.03	0.02	0.00	0.00	3.30
Off-Site Dredge to Beneficial Re-Use Areas																
Booster Pump	Pumps Composite	2	20	750	210	7.70	92.54	30.70	2.73	2.51	0.81	9.72	3.22	0.29	0.26	1,461.42
Nesting Site/Transitional Areas																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	3	10	290	12	2.18	18.18	7.17	0.59	0.54	0.01	0.11	0.04	0.00	0.00	18.87
Bulldozer	Rubber Tired Dozers Composite	2	10	300	12	2.96	24.49	8.45	1.02	0.94	0.02	0.15	0.05	0.01	0.01	13.46
Off-road Hauler	Off-Highway Trucks Composite	3	10	725	12	6.43	47.80	19.39	1.68	1.54	0.04	0.29	0.12	0.01	0.01	48.55
Install Internal Revetments/Shore Protection																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	2	10	290	39	1.45	12.12	4.78	0.39	0.36	0.03	0.24	0.09	0.01	0.01	40.88
Front-end Loaders	Rubber Tired Loaders Composite	2	10	250	39	1.50	13.25	4.61	0.45	0.42	0.03	0.26	0.09	0.01	0.01	35.47
Highway 101 Bridge and Approaches																
Install Formwork, Rebar & Misc Items																
Crane	Cranes Composite	1	10	250	72	0.62	5.55	1.82	0.19	0.18	0.02	0.20	0.07	0.01	0.01	24.66
Forklift	Forklifts Composite	1	10	120	72	0.23	1.56	1.44	0.12	0.11	0.01	0.06	0.05	0.00	0.00	6.87
Place Concrete																
Concrete Pump	Pumps Composite	1	6	250	30	0.44	5.33	1.61	0.15	0.14	0.01	0.08	0.02	0.00	0.00	11.06
Excavation & Backfill - Bridge																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	1	2	290	9	0.15	1.21	0.48	0.04	0.04	0.00	0.01	0.00	0.00	0.00	0.94
Front-end Loaders	Rubber Tired Loaders Composite	1	2	250	9	0.15	1.33	0.46	0.05	0.04	0.00	0.01	0.00	0.00	0.00	0.82
Excavation & Backfill - Road																
Front-end Loaders	Rubber Tired Loaders Composite	2	10	250	74	1.50	13.25	4.61	0.45	0.42	0.06	0.49	0.17	0.02	0.02	67.31
Aggregate Base																
Motor Grader	Graders Composite	1	10	150	74	0.87	6.39	4.90	0.35	0.32	0.03	0.24	0.18	0.01	0.01	28.01
Asphalt Concrete																
Asphalt Paver	Pavers Composite	1	10	130	17	0.65	3.94	2.61	0.34	0.31	0.01	0.03	0.02	0.00	0.00	2.83
Roller	Rollers Composite	2	10	130	17	1.15	7.37	5.36	0.61	0.56	0.01	0.06	0.05	0.01	0.00	6.13
Indirect Support																
Front-end Loaders	Rubber Tired Loaders Composite	1	6	250	168	0.45	3.98	1.38	0.14	0.12	0.04	0.33	0.12	0.01	0.01	45.84
Motor Grader	Graders Composite	1	6	150	168	0.52	3.83	2.94	0.21	0.19	0.04	0.32	0.25	0.02	0.02	38.16
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	1	6	290	168	0.44	3.64	1.43	0.12	0.11	0.04	0.31	0.12	0.01	0.01	52.84
Water Truck	Off-Highway Trucks	1	6	175	168	0.51	3.46	3.04	0.19	0.18	0.04	0.29	0.26	0.02	0.01	38.51
Total						**38.09**	**337.38**	**132.86**	**12.67**	**11.66**	**1.64**	**16.54**	**6.10**	**0.56**	**0.52**	**2,306.23**

On Road Construction Emissions

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
	Trips Per Day	Distance	Average Daily Mileage	Calculated Time - Rounded (days)	Total Mileage	ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Clear & Grub																
Dump Truck (7)	42	24	1,008	168	169,344	0.66	19.92	2.98	0.51	0.35	0.06	1.67	0.25	0.04	0.03	288.11
Demolition of Hwy 101																
Dump Truck (2)	63	24	1,500	13	19,500	0.98	29.65	4.43	0.76	0.52	0.01	0.19	0.03	0.00	0.00	33.18
Install Internal Revetments/Shore Protection																
Dump Truck (13)	45	24	1,073	39	41,839	0.70	21.20	3.17	0.55	0.37	0.01	0.41	0.06	0.01	0.01	71.18
Concrete Delivery Trucks																
Concrete Truck (3)	6	24	144	30	4,320	0.09	2.85	0.43	0.07	0.05	0.00	0.04	0.01	0.00	0.00	7.35
Other Delivery Trucks																
Delivery Truck	2	24	48	9	432	0.03	0.95	0.14	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.73
Dump Trucks																
Dump Truck (38)	75	24	1,800	74	133,200	1.17	35.58	5.32	0.91	0.63	0.04	1.32	0.20	0.03	0.02	226.62
Base & Asphalt Trucks																
Dump Truck (3)	5	24	120	74	8,880	0.08	2.37	0.35	0.06	0.04	0.00	0.09	0.01	0.00	0.00	15.11
Indirect Support																
Dump Truck (1)	2	24	48	168	8,064	0.03	0.95	0.14	0.02	0.02	0.00	0.08	0.01	0.00	0.00	13.72
Total			**5,741**	**575**	**385,579**	**3.74**	**113.47**	**16.96**	**2.92**	**2.00**	**0.13**	**3.81**	**0.57**	**0.10**	**0.07**	**656.00**

Notes: Utility Road Surfact (Agg. Base) dump truck trips assumes 2.1194 tons of stone in 1 cy. Number in () after equipment name represents the number of equipment.
Haul distance assumes that materials from the site will be hauled off and disposed of at the Mira Mar landfill located approximately 24 miles roundtrip from the site in San Diego

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
	Total Trips	Distance	Average Daily Mileage	Total Mileage		ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Worker Trips	120	16.8	2,016	338,688		0.23	1.89	4.49	0.29	0.16	0.02	0.16	0.38	0.02	0.01	115.79

Note: Assumes a total of 40 workers per day and 20 visitors per day, consistent with the traffic report for the proposed project.

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
Total						ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
						42.06	452.74	154.31	15.88	13.82	1.78	20.51	7.05	0.68	0.60	3,078.02

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Number of Construction Days	168
Number of Pump Construction Days	210

Alternative 2A - Construction - Phase 3

Off-Road Construction Equipment

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
Equipment Type	Equipment Category	Number	Usage Factor (hrs/day)	Power Rating (hp)	Calculated Time - Rounded (days)	ROG	NOX	CO	PM10	PM2.5	ROG	NOX	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Clear & Grub																
Bulldozer	Rubber Tired Dozers Composite	2	10	300	17	2.96	24.49	8.45	1.02	0.94	0.03	0.21	0.07	0.01	0.01	19.02
Front-end Loaders	Rubber Tired Loaders Composite	2	10	250	17	1.50	13.25	4.61	0.45	0.42	0.01	0.11	0.04	0.00	0.00	15.44
Off-Site Dredge to Beneficial Re-Use Areas																
Booster Pump	Pumps Composite	2	20	750	210	7.70	92.54	30.70	2.73	2.51	0.81	9.72	3.22	0.29	0.26	1,461.42
Nesting Site/Transitional Areas																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	3	10	290	12	2.18	18.18	7.17	0.59	0.54	0.01	0.11	0.04	0.00	0.00	18.87
Bulldozer	Rubber Tired Dozers Composite	2	10	300	12	2.96	24.49	8.45	1.02	0.94	0.02	0.15	0.05	0.01	0.01	13.46
Off-road Hauler	Off-Highway Trucks Composite	3	10	725	12	6.43	47.80	19.39	1.68	1.54	0.04	0.29	0.12	0.01	0.01	48.55
Install Internal Revetments/Shore Protection																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	2	10	290	39	1.45	12.12	4.78	0.39	0.36	0.03	0.24	0.09	0.01	0.01	40.88
Front-end Loaders	Rubber Tired Loaders Composite	2	10	250	39	1.50	13.25	4.61	0.45	0.42	0.03	0.26	0.09	0.01	0.01	35.47
Highway 101 Bridge and Approaches																
Place Concrete																
Concrete Pump	Pumps Composite	1	6	300	30	0.44	5.33	1.61	0.15	0.14	0.01	0.08	0.02	0.00	0.00	11.06
Excavation & Backfill - Bridge																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	1	2	290	9	0.15	1.21	0.48	0.04	0.04	0.00	0.01	0.00	0.00	0.00	0.94
Front-end Loaders	Rubber Tired Loaders Composite	1	2	250	9	0.15	1.33	0.46	0.05	0.04	0.00	0.01	0.00	0.00	0.00	0.82
Excavation & Backfill - Road																
Front-end Loaders	Rubber Tired Loaders Composite	2	10	250	74	1.50	13.25	4.61	0.45	0.42	0.06	0.49	0.17	0.02	0.02	67.31
Aggregate Base																
Motor Grader	Graders Composite	1	10	150	74	0.87	6.39	4.90	0.35	0.32	0.03	0.24	0.18	0.01	0.01	28.01
Asphalt Concrete																
Asphalt Paver	Pavers Composite	1	10	130	17	0.65	3.94	2.61	0.34	0.31	0.01	0.03	0.02	0.00	0.00	2.83
Roller	Rollers Composite	2	10	130	17	1.15	7.37	5.36	0.61	0.56	0.01	0.06	0.05	0.01	0.00	6.13
Indirect Support																
Front-end Loaders	Rubber Tired Loaders Composite	1	6	250	168	0.45	3.98	1.38	0.14	0.12	0.04	0.33	0.12	0.01	0.01	45.84
Motor Grader	Graders Composite	1	6	150	168	0.52	3.83	2.94	0.21	0.19	0.04	0.32	0.25	0.02	0.02	38.16
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	1	6	290	168	0.44	3.64	1.43	0.12	0.11	0.04	0.31	0.12	0.01	0.01	52.84
Water Truck	Off-Highway Trucks	1	6	175	168	0.51	3.46	3.04	0.19	0.18	0.04	0.29	0.26	0.02	0.01	38.51
Total						**33.48**	**299.83**	**116.99**	**10.98**	**10.10**	**1.24**	**13.24**	**4.91**	**0.43**	**0.40**	**1,945.56**

On Road Construction Emissions

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
	Trips Per Day	Distance	Average Daily Mileage	Calculated Time - Rounded (days)	Total Mileage	ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Clear & Grub																
Dump Truck (7)	42	24	1,008	168	169,344	0.66	19.92	2.98	0.51	0.35	0.06	1.67	0.25	0.04	0.03	288.11
Install Internal Revetments/Shore Protection																
Dump Truck (13)	45	24	1,073	39	41,839	0.70	21.20	3.17	0.55	0.37	0.01	0.41	0.06	0.01	0.01	71.18
Concrete Delivery Trucks																
Concrete Truck (3)	6	24	144	30	4,320	0.09	2.85	0.43	0.07	0.05	0.00	0.04	0.01	0.00	0.00	7.35
Other Delivery Trucks																
Delivery Truck	2	24	48	9	432	0.03	0.95	0.14	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.73
Dump Trucks																
Dump Truck (38)	75	24	1,800	74	133,200	1.17	35.58	5.32	0.91	0.63	0.04	1.32	0.20	0.03	0.02	226.60
Base & Asphalt Trucks																
Dump Truck (3)	5	24	120	74	8,880	0.08	2.37	0.35	0.06	0.04	0.00	0.09	0.01	0.00	0.00	15.11
Indirect Support																
Dump Truck (1)	2	24	48	168	8,064	0.03	0.95	0.14	0.02	0.02	0.00	0.08	0.01	0.00	0.00	13.72
Total		**4,241**		**562**	**366,079**	**2.76**	**83.82**	**12.53**	**2.16**	**1.47**	**0.12**	**3.62**	**0.54**	**0.09**	**0.06**	**622.81**

Notes: Utility Road Surfact (Agg. Base) dump truck trips assumes 2.1194 tons of stone in 1 cy. Number in () after equipment name represents the number of equipment.
Haul distance assumes that materials from the site will be hauled off and disposed of at the Mira Mar landfill located approximately 24 miles roundtrip from the site in San Diego

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
	Total Trips	Distance	Average Daily Mileage	Total Mileage		ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Worker Trips	120	16.8	2,016	338,688		0.23	1.89	4.49	0.29	0.16	0.02	0.16	0.38	0.02	0.01	115.79

Note: Assumes a total of 40 workers per day and 20 visitors per day, consistent with the traffic report for the proposed project.

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
Total						ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
						36.47	385.55	134.00	13.42	11.74	1.38	17.02	5.83	0.55	0.47	2,684.16

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Number of Construction Days	168
Number of Pump Construction Days	210

Alternative 2A - Construction - Phase 4

Off-Road Construction Equipment

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
Equipment Type	Equipment Category	Number	Usage Factor (hrs/day)	Power Rating (hp)	Calculated Time - Rounded (days)	ROG	NOX	CO	PM10	PM2.5	ROG	NOX	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Clear & Grub																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	3	10	290	6	2.18	18.18	7.17	0.59	0.54	0.01	0.05	0.02	0.00	0.00	9.42
Bulldozer	Rubber Tired Dozers Composite	2	10	300	6	2.96	24.49	8.45	1.02	0.94	0.01	0.07	0.03	0.00	0.00	6.71
Off-Site Dredge to Beneficial Re-Use Areas																
Booster Pump	Pumps Composite	2	20	750	150	7.70	92.54	30.70	2.73	2.51	0.58	6.94	2.30	0.20	0.19	1,043.87
Install Internal Revetments/Shore Protection																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	2	10	290	10	1.45	12.12	4.78	0.39	0.36	0.01	0.06	0.02	0.00	0.00	10.47
Front-end Loaders	Rubber Tired Loaders Composite	2	10	250	10	1.50	13.25	4.61	0.45	0.42	0.01	0.07	0.02	0.00	0.00	9.08
Revegetation (minor equipment)																
Scour Protection																
Crane	Cranes	1	10	250	10	0.62	5.55	1.82	0.19	0.18	0.00	0.03	0.01	0.00	0.00	3.42
Excavation & Disposal (Beach Fill)																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	3	10	290	10	2.18	18.18	7.17	0.59	0.54	0.01	0.09	0.04	0.00	0.00	15.71
Bulldozer	Rubber Tired Dozers Composite	2	10	300	10	2.96	24.49	8.45	1.02	0.94	0.01	0.12	0.04	0.01	0.00	11.19
Motor Grader	Graders Composite	1	2	150	10	0.17	1.28	0.98	0.07	0.06	0.00	0.01	0.00	0.00	0.00	0.76
Cobble Blocking Features																
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	1	10	290	21	0.73	6.06	2.39	0.20	0.18	0.01	0.06	0.03	0.00	0.00	10.99
Front-end Loaders	Rubber Tired Loaders Composite	1	10	250	21	0.75	6.63	2.31	0.23	0.21	0.01	0.07	0.02	0.00	0.00	9.54
Indirect Support																
Front-end Loaders	Rubber Tired Loaders Composite	1	6	250	120	0.45	3.98	1.38	0.14	0.12	0.03	0.24	0.08	0.01	0.01	32.70
Motor Grader	Graders Composite	1	6	150	120	0.52	3.83	2.94	0.21	0.19	0.03	0.23	0.18	0.01	0.01	27.20
Hydl. Backhoe	Tractors/Loaders/Backhoes Composite	1	6	290	120	0.44	3.64	1.43	0.12	0.11	0.03	0.22	0.09	0.01	0.01	37.69
Water Truck	Off-Highway Trucks	1	6	175	120	0.51	3.46	3.04	0.19	0.18	0.03	0.21	0.18	0.01	0.01	27.46
Total						**25.10**	**237.67**	**87.62**	**8.14**	**7.49**	**0.77**	**8.47**	**3.07**	**0.27**	**0.25**	**1,256.21**

On Road Construction Emissions

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
	Trips Per Day	Distance	Average Daily Mileage	Calculated Time - Rounded (days)	Total Mileage	ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Excavation & Disposal (Beach Fill)																
Dump Truck (2)	42	1	42	10	417	0.03	0.82	0.12	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.71
Cobble Blocking Features																
Dump Truck (6)	21	24	494	21	10,382	0.32	9.77	1.46	0.25	0.17	0.00	0.10	0.02	0.00	0.00	17.66
Indirect Support																
Dump Truck (1)	2	24	48	120	5,760	0.03	0.95	0.14	0.02	0.02	0.00	0.06	0.01	0.00	0.00	9.80
Total			**584**	**151**	**16,559**	**0.38**	**11.55**	**1.73**	**0.30**	**0.20**	**0.01**	**0.16**	**0.02**	**0.00**	**0.00**	**28.17**

Notes: Utility Road Surfact (Agg. Base) dump truck trips assumes 2.1194 tons of stone in 1 cy. Number in () after equipment name represents the number of equipment.
Haul distance assumes that materials from the site will be hauled off and disposed of at the Mira Mar landfill located approximately 24 miles roundtrip from the site in San Diego

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
	Total Trips	Distance	Average Daily Mileage	Total Mileage		ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
Worker Trips	120	16.8	4,032	483,840		0.45	3.78	8.98	0.58	0.33	0.03	0.23	0.54	0.03	0.02	165.41

Note: Assumes a total of 40 workers per day and 20 visitors per day, consistent with the traffic report for the proposed project.

						Emissions Summary (lbs/day)					Emissions Summary (tons per phase)					
Total						ROG	NO_x	CO	PM10	PM2.5	ROG	NO_x	CO	PM10	PM2.5	Total GHG Emissions (MT CO2e)
						25.93	252.99	98.32	9.02	8.02	0.80	8.86	3.63	0.31	0.27	1,449.79

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Number of Construction Days	120
Number of Pump Construction Days	150

Alternative 2A - Dredge Emissions - Phase 1

Assumptions

Main Generator Engine	2560	bhp
	1909.0	kW
Aux Generator Engines	750	bhp
	559.3	kW
Number	1.0	

			Emissions (pounds per day)					Emissions (tons per phase)					Emissions (metric tons per phase)
Activity	Number of Construction Days	Time (hours per day)	ROG	NOx	CO	PM10	PM2.5	ROG	NOx	CO	PM10	PM2.5	CO2e*
Dredge	390	20	48.23	447.76	199.07	16.07	14.78	9.40	87.31	38.82	3.13	2.88	5,949.44

*To account for N20 and CH4 emissions, an extra 5% was added to the CO2 emissions.

Main Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
3300 hp	0.70	7.30	2.92	0.29	0.27	652	184.16

Note: CO2 emission factor in g/kWh

Source: ARB Harborcraft Emission Inventory Database

Auxiliary Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
1000 hp	0.84	6.82	3.42	0.26	0.24	652	184.16

Note: CO2 emission factor in g/kWh

Source: ARB Harborcraft Emission Inventory Database

CO2 emissions factor from Port of Long Beach. 2011 Emissions Inventory. Available at http://www.polb.com/environment/air/emissions.asp.

Load Factor

Engine	Load factor
Propulsion	0.45
Auxiliary	0.45

Source: ARB. Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

Table II-4 Fuel Correction Factor

Calendar Years	Horsepower Range	Model Years	NOx	PM
1994-2006	<25	Pre-1995	0.930	0.750
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.822
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
2007+	<25	Pre-1995	0.930	0.720
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.800
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
	All	2011+	0.948	0.852

Source: Off-road Exhaust Emissions Inventory Fuel Correction Factors *(2)*

Calendar Years	Horsepower Range	Model Years	NOx	PM
2007+	All	2011+	0.948	0.852

Source: ARB, Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

The basic equation for the estimating emissions from a commercial harbor craft engine is:

$$E = EF_0 \times F \times (1 + D \times \frac{A}{UL}) \times HP \times LF \times Hr$$

Where:

E is the amount of emissions of a pollutant (ROG, CO, NOx, or PM) emitted during one period; [7]
EF$_0$ is the model year, horsepower and engine use (propulsion or auxiliary) specific zero hour emission factor (when engine is new);
F is the fuel correction factor which accounts for emission reduction benefits from burning cleaner fuel;
D is the horsepower and pollutant specific engine deterioration factor, which is the percentage increase of emission factors at the end of the useful life of the engine;
A is the age of the engine when the emissions are estimated;
UL is the vessel type and engine use specific engine useful life;
HP is rated horsepower of the engine;
LF is the vessel type and engine use specific engine load factor;
Hr is the number of annual operating hours of the engine.

Alternative 2A - Electric Dredge Emissions - Phase 1

Assumptions

Main Generator Engine	2560	bhp
	1909.0	kW
Aux Generator Engines	750	bhp
	559.3	kW
Total kW	2468.2	

				Emissions (metric tons per phase)
Activity	**Number of Construction Days**	**Time (hours per day)**	**Daily Energy Consumption (kWh)**	**CO2e***
Dredge	390	20	49,364.68	6,391.91

	Emission Factors (lb/MWh)
CO_2	720.490
N_2O	0.029
CH_4	0.010

Source: Climate Action Registry, 2012. SDG&E 2009 Annual Entity Emissions: Electric Power Generation/Electric Utility Sector.

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Alternative 2A - Dredge Emissions - Phase 2

Assumptions

Main Generator Engine	2560	bhp
	1909.0	kW
Aux Generator Engines	750	bhp
	559.3	kW
Number	1.0	

			Emissions (pounds per day)					Emissions (tons per phase)					Emissions (metric tons per phase)
Activity	Number of Construction Days	Time (hours per day)	ROG	NOx	CO	PM10	PM2.5	ROG	NOx	CO	PM10	PM2.5	CO2e*
Dredge	210	20	48.23	447.76	199.07	16.07	14.78	5.06	47.01	20.90	1.69	1.55	3,203.54

*To account for N20 and CH4 emissions, an extra 5% was added to the CO2 emissions.

Main Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
3300 hp	0.70	7.30	2.92	0.29	0.27	652	184.16

Note: CO2 emission factor in g/kWh

Source: ARB Harborcraft Emission Inventory Database

Auxiliary Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
1000 hp	0.84	6.82	3.42	0.26	0.24	652	184.16

Note: CO2 emission factor in g/kWh

Source: ARB Harborcraft Emission Inventory Database

CO2 emissions factor from Port of Long Beach. 2011 Emissions Inventory. Available at http://www.polb.com/environment/air/emissions.asp.

Load Factor

Engine	Load factor
Propulsion	0.45
Auxiliary	0.45

Source: ARB. Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

Table II-4 Fuel Correction Factor

Calendar Years	Horsepower Range	Model Years	NOx	PM
1994-2006	<25	Pre-1995	0.930	0.750
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.822
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
2007+	<25	Pre-1995	0.930	0.720
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.800
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
	All	2011+	0.948	0.852

Source: Off-road Exhaust Emissions Inventory Fuel Correction Factors *(2)*

Calendar Years	Horsepower Range	Model Years	NOx	PM
2007+	All	2011+	0.948	0.852

Source: ARB, Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

The basic equation for the estimating emissions from a commercial harbor craft engine is:

$$E = EF_0 \times F \times (1 + D \times \frac{A}{UL}) \times HP \times LF \times Hr$$

Where:

E is the amount of emissions of a pollutant (ROG, CO, NOx, or PM) emitted during one period; [7]
EF$_0$ is the model year, horsepower and engine use (propulsion or auxiliary) specific zero hour emission factor (when engine is new);
F is the fuel correction factor which accounts for emission reduction benefits from burning cleaner fuel;
D is the horsepower and pollutant specific engine deterioration factor, which is the percentage increase of emission factors at the end of the useful life of the engine;
A is the age of the engine when the emissions are estimated;
UL is the vessel type and engine use specific engine useful life;
HP is rated horsepower of the engine;
LF is the vessel type and engine use specific engine load factor;
Hr is the number of annual operating hours of the engine.

Alternative 2A - Electric Dredge Emissions - Phase 2

Assumptions

Main Generator Engine	2560	bhp
	1909.0	kW
Aux Generator Engines	750	bhp
	559.3	kW
Total kW	2468.2	

				Emissions (metric tons per phase)
Activity	**Number of Construction Days**	**Time (hours per day)**	**Daily Energy Consumption (kWh)**	**CO2e***
Dredge	210	20	49,364.68	3,441.80

	Emission Factors (lb/MWh)
CO_2	720.490
N_2O	0.029
CH_4	0.010

Source: Climate Action Registry, 2012. SDG&E 2009 Annual Entity Emissions: Electric Power Generation/Electric Utility Sector.

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Alternative 2A - Dredge Emissions - Phase 3

Assumptions

Main Generator Engine	2560	bhp
	1909.0	kW
Aux Generator Engines	750	bhp
	559.3	kW
Number	1.0	

			Emissions (pounds per day)					Emissions (tons per phase)					Emissions (metric tons per phase)
Activity	Number of Construction Days	Time (hours per day)	ROG	NOx	CO	PM10	PM2.5	ROG	NOx	CO	PM10	PM2.5	CO2e*
Dredge	210	20	48.23	447.76	199.07	16.07	14.78	5.06	47.01	20.90	1.69	1.55	3,203.54

*To account for N20 and CH4 emissions, an extra 5% was added to the CO2 emissions.

Main Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
3300 hp	0.70	7.30	2.92	0.29	0.27	652	184.16

Note: CO2 emission factor in g/kWh

Source: ARB Harborcraft Emission Inventory Database

Auxiliary Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
1000 hp	0.84	6.82	3.42	0.26	0.24	652	184.16

Note: CO2 emission factor in g/kWh

Source: ARB Harborcraft Emission Inventory Database

CO2 emissions factor from Port of Long Beach. 2011 Emissions Inventory. Available at http://www.polb.com/environment/air/emissions.asp.

Load Factor

Engine	Load factor
Propulsion	0.45
Auxiliary	0.45

Source: ARB. Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

Table II-4 Fuel Correction Factor

Calendar Years	Horsepower Range	Model Years	NOx	PM
1994-2006	<25	Pre-1995	0.930	0.750
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.822
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
2007+	<25	Pre-1995	0.930	0.720
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.800
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
	All	2011+	0.948	0.852

Source: Off-road Exhaust Emissions Inventory Fuel Correction Factors *(2)*

Calendar Years	Horsepower Range	Model Years	NOx	PM
2007+	All	2011+	0.948	0.852

Source: ARB, Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

The basic equation for the estimating emissions from a commercial harbor craft engine is:

$$E = EF_0 \times F \times (1 + D \times \frac{A}{UL}) \times HP \times LF \times Hr$$

Where:

E is the amount of emissions of a pollutant (ROG, CO, NOx, or PM) emitted during one period; [7]
EF$_0$ is the model year, horsepower and engine use (propulsion or auxiliary) specific zero hour emission factor (when engine is new);
F is the fuel correction factor which accounts for emission reduction benefits from burning cleaner fuel;
D is the horsepower and pollutant specific engine deterioration factor, which is the percentage increase of emission factors at the end of the useful life of the engine;
A is the age of the engine when the emissions are estimated;
UL is the vessel type and engine use specific engine useful life;
HP is rated horsepower of the engine;
LF is the vessel type and engine use specific engine load factor;
Hr is the number of annual operating hours of the engine.

Alternative 2A - Electric Dredge Emissions - Phase 3

Assumptions

Main Generator Engine	2560	bhp
	1909.0	kW
Aux Generator Engines	750	bhp
	559.3	kW
Total kW	2468.2	

Activity	Number of Construction Days	Time (hours per day)	Daily Energy Consumption (kWh)	Emissions (metric tons per phase) CO2e*
Dredge	210	20	49,364.68	3,441.80

	Emission Factors (lb/MWh)
CO_2	720.490
N_2O	0.029
CH_4	0.010

Source: Climate Action Registry, 2012. SDG&E 2009 Annual Entity Emissions: Electric Power Generation/Electric Utility Sector.

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Alternative 2A - Dredge Emissions - Phase 4

Assumptions

Main Generator Engine	2560	bhp
	1909.0	kW
Aux Generator Engines	750	bhp
	559.3	kW
Number	1.0	

			Emissions (pounds per day)					Emissions (tons per phase)					Emissions (metric tons per phase)
Activity	Number of Construction Days	Time (hours per day)	ROG	NOx	CO	PM10	PM2.5	ROG	NOx	CO	PM10	PM2.5	CO2e*
Dredge	150	20	48.23	447.76	199.07	16.07	14.78	3.62	33.58	14.93	1.20	1.11	2,288.25

*To account for N20 and CH4 emissions, an extra 5% was added to the CO2 emissions.

Main Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
3300 hp	0.70	7.30	2.92	0.29	0.27	652	184.16

Note: CO2 emission factor in g/kWh

Source: ARB Harborcraft Emission Inventory Database

Auxiliary Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
1000 hp	0.84	6.82	3.42	0.26	0.24	652	184.16

Note: CO2 emission factor in g/kWh

Source: ARB Harborcraft Emission Inventory Database

CO2 emissions factor from Port of Long Beach. 2011 Emissions Inventory. Available at http://www.polb.com/environment/air/emissions.asp.

Load Factor

Engine	Load factor
Propulsion	0.45
Auxiliary	0.45

Source: ARB. Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

Table II-4 Fuel Correction Factor

Calendar Years	Horsepower Range	Model Years	NOx	PM
1994-2006	<25	Pre-1995	0.930	0.750
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.822
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
2007+	<25	Pre-1995	0.930	0.720
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.800
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
	All	2011+	0.948	0.852

Source: Off-road Exhaust Emissions Inventory Fuel Correction Factors *(2)*

Calendar Years	Horsepower Range	Model Years	NOx	PM
2007+	All	2011+	0.948	0.852

Source: ARB, Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

The basic equation for the estimating emissions from a commercial harbor craft engine is:

$$E = EF_0 \times F \times (1 + D \times \frac{A}{UL}) \times HP \times LF \times Hr$$

Where:

E is the amount of emissions of a pollutant (ROG, CO, NOx, or PM) emitted during one period; [7]
EF$_0$ is the model year, horsepower and engine use (propulsion or auxiliary) specific zero hour emission factor (when engine is new);
F is the fuel correction factor which accounts for emission reduction benefits from burning cleaner fuel;
D is the horsepower and pollutant specific engine deterioration factor, which is the percentage increase of emission factors at the end of the useful life of the engine;
A is the age of the engine when the emissions are estimated;
UL is the vessel type and engine use specific engine useful life;
HP is rated horsepower of the engine;
LF is the vessel type and engine use specific engine load factor;
Hr is the number of annual operating hours of the engine.

Alternative 2A - Electric Dredge Emissions - Phase 4

Assumptions

Main Generator Engine	2560	bhp
	1909.0	kW
Aux Generator Engines	750	bhp
	559.3	kW
Total kW	2468.2	

Activity	Number of Construction Days	Time (hours per day)	Daily Energy Consumption (kWh)	Emissions (metric tons per phase) CO2e*
Dredge	150	20	49,364.68	2,458.43

	Emission Factors (lb/MWh)
CO_2	720.490
N_2O	0.029
CH_4	0.010

Source: Climate Action Registry, 2012. SDG&E 2009 Annual Entity Emissions: Electric Power Generation/Electric Utility Sector.

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Alternative 2A - Material Disposal

Assumptions

Main Generator Engine	5000 bhp
	3728.5 kW
Aux Generator Engines	3000 bhp
	2237.1 kW
Number	1.0

			Emissions (pounds per day)						Emissions (tons)						Emissions (metric tons per phase)
Activity	Number of Construction Days	Time (hours per day)	ROG	NOx	CO	PM10	PM2.5	CO2e*	ROG	NOx	CO	PM10	PM2.5	CO2e*
Leucadia/Torrey Pines	72.40	2.12	12.71	115.59	52.36	4.28	3.94	8603.89	0.46	4.18	1.90	0.15	0.14	283.43
Moonlight Beach	21.00	0.77	4.62	42.03	19.04	1.56	1.43	3128.69	0.05	0.44	0.20	0.02	0.02	29.89
Solana Beach	29.20	0.39	2.31	21.02	9.52	0.78	0.72	1564.34	0.03	0.31	0.14	0.01	0.01	20.78
Total	122.60	3.28	12.71	115.59	52.36	4.28	3.94	8603.89	0.54	4.93	2.23	0.18	0.17	334.11

Notes: Assumes 1 tug round trip per day. Each tug would transport 2 barges per trip.
*To account for N20 and CH4 emissions, an extra 5% was added to the CO2 emissions.

Main Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
5000 hp	0.70	7.42	2.92	0.31	0.29	652	184.16

Note: CO2 emission factor in g/kWh
Source: ARB Harborcraft Emission Inventory Database

Auxiliary Engine - 2015 Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
3300 hp	0.84	6.93	3.42	0.27	0.25	652	184.16

Note: CO2 emission factor in g/kWh
Source: ARB Harborcraft Emission Inventory Database
CO2 emissions factor from Port of Long Beach. 2011 Emissions Inventory. Available at http://www.polb.com/environment/air/emissions.asp.

Load Factor

Engine	Load factor
Propulsion	0.45
Auxiliary	0.45

Source: ARB. Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

Table II-4 Fuel Correction Factor

Calendar Years	Horsepower Range	Model Years	NOx	PM
1994-2006	<25	Pre-1995	0.930	0.750
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.822
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
2007+	<25	Pre-1995	0.930	0.720
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.800
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
	All	2011+	0.948	0.852

Source: Off-road Exhaust Emissions Inventory Fuel Correction Factors *(2)*

Calendar Years	Horsepower Range	Model Years	NOx	PM
2007+	All	2011+	0.948	0.852

Source: ARB, Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

The basic equation for the estimating emissions from a commercial harbor craft engine is:

$$E = EF_0 \times F \times (1 + D \times \frac{A}{UL}) \times HP \times LF \times Hr$$

Where:

E is the amount of emissions of a pollutant (ROG, CO, NOx, or PM) emitted during one period: *7*
EF_0 is the model year, horsepower and engine use (propulsion or auxiliary) specific zero hour emission factor (when engine is new);
F is the fuel correction factor which accounts for emission reduction benefits from burning cleaner fuel;
D is the horsepower and pollutant specific engine deterioration factor, which is the percentage increase of emission factors at the end of the useful life of the engine;
A is the age of the engine when the emissions are estimated;
UL is the vessel type and engine use specific engine useful life;
HP is rated horsepower of the engine;
LF is the vessel type and engine use specific engine load factor;
Hr is the number of annual operating hours of the engine.

Alternative 2A - Operations

Off-Road Construction Equipment

					Emissions Summary (lbs/day)					Emissions Summary (tons/year)					
Equipment Type	**Equipment Category**	**Number**	**Usage Factor**	**Unit**	**ROG**	**NOX**	**CO**	**PM10**	**PM2.5**	**ROG**	**NOX**	**CO**	**PM10**	**PM2.5**	**Total GHG Emissions (MT CO2e)**
Rubber Tired Dozer	Rubber Tired Dozers Composite	1	10	hrs/day	1.42	10.57	5.36	0.42	0.39	0.09	0.63	0.32	0.03	0.02	
Backhoe	Tractors/Loaders/Backhoes Composite	1	10	hrs/day	0.29	1.84	2.42	0.09	0.08	0.02	0.11	0.15	0.01	0.00	
Off-Highway Trucks	Off-Highway Trucks Composite	2	10	hrs/day	1.93	11.13	7.39	0.38	0.35	0.12	0.67	0.44	0.02	0.02	
Pump	Booster Pump	2	20	hrs/day	5.56	51.23	27.42	1.59	1.47	0.42	3.84	2.06	0.12	0.11	
					9.21	74.76	42.60	2.48	2.28	0.64	5.25	2.97	0.17	0.16	1347.15

On Road Construction Emissions

					Emissions Summary (lbs/day)					Emissions Summary (tons/year)					
	Trips Per Day	**Distance**	**Average Daily Mileage**	**Total Mileage**	**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**Total GHG Emissions (MT CO2e)**
Heavy-Duty Trucks	2	12	24	2,880	0.01	0.22	0.05	0.01	0.01	0.001	0.013	0.003	0.001	0.000	4
Total			**24**	**2,880**	**0.01**	**0.22**	**0.05**	**0.01**	**0.01**	**0.00**	**0.01**	**0.00**	**0.00**	**0.00**	**4.48**

Note: Assumes 1 miscellaneous round truck trip per day.

					Emissions Summary (lbs/day)					Emissions Summary (tons/year)					
	Total Trips	**Distance**	**Average Daily Mileage**	**Total Mileage**	**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**Total GHG Emissions (MT CO2e)**
Worker Trips	80	16.8	1,344	161,280	0.08	1.85	0.84	0.16	0.08	0.00	0.11	0.05	0.01	0.00	46.17

Note: Assumes a total of 40 workers per day.

					Emissions Summary (lbs/day)					Emissions Summary (tons/year)					
Total					**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**ROG**	**NO_x**	**CO**	**PM10**	**PM2.5**	**Total GHG Emissions (MT CO2e)**
					9.29	76.84	43.49	2.65	2.37	0.64	5.38	3.02	0.18	0.16	1,397.80

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Number of Construction Days	120
Number of Pump Construction Days	150

Alternative 2A - Operations - Dredge

Assumptions

Main Generator Engine	2560	bhp
	1909.0	kW
Aux Generator Engine	750	bhp
	559.3	kW
Number	1.0	

			Emissions (pounds per day)					Emissions (tons per year)					
Activity	**Number of Construction Days**	**Time (hours per day)**	**ROG**	**NOx**	**CO**	**PM10**	**PM2.5**	**ROG**	**NOx**	**CO**	**PM10**	**PM2.5**	**CO2e***
Dredge	150	20	38.32	301.20	213.93	10.43	9.60	2.87	22.59	16.04	0.78	0.72	2,288.25

*To account for N20 and CH4 emissions, an extra 5% was added to the CO2 emissions.

Main Engine - Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
3300 hp	0.55	4.83	3.20	0.19	0.18	652	184.16

Note: CO2 emission factor in g/kWh

Source: ARB Harborcraft Emission Inventory Database

Auxiliary Engine - Emission Factors (g/bhp-hr)

	ROG	NOx	CO	PM10	PM2.5	CO2	Fuel
1000 hp	0.68	4.86	3.45	0.17	0.16	652	184.16

Note: CO2 emission factor in g/kWh

Source: ARB Harborcraft Emission Inventory Database

CO2 emissions factor from Port of Long Beach. 2011 Emissions Inventory. Available at http://www.polb.com/environment/air/emissions.asp.

Load Factor

Engine	Load factor
Propulsion	0.45
Auxiliary	0.45

Source: ARB. Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in Californi

Table II-4 Fuel Correction Factor

Calendar Years	Horsepower Range	Model Years	NOx	PM
1994-2006	<25	Pre-1995	0.930	0.750
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.822
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
2007+	<25	Pre-1995	0.930	0.720
	25-50	Pre-1999		
	51-100	Pre-1998		
	101-175	Pre-1997		
	176+	Pre-1996		
	<25	1995+	0.948	0.800
	25-50	1999-2010		
	51-100	1998-2010		
	101-175	1997-2010		
	176+	1996-2010		
	All	2011+	0.940	0.052

Source: Off-road Exhaust Emissions Inventory Fuel Correction Factors *(2)*

The basic equation for the estimating emissions from a commercial harbor craft engine is:

$$E = EF_0 \times F \times (1 + D \times \frac{A}{UL}) \times HP \times LF \times Hr$$

Where:

E is the amount of emissions of a pollutant (ROG, CO, NOx, or PM) emitted during one period; [7]
EF₀ is the model year, horsepower and engine use (propulsion or auxiliary) specific zero hour emission factor (when engine is new);
F is the fuel correction factor which accounts for emission reduction benefits from burning cleaner fuel;
D is the horsepower and pollutant specific engine deterioration factor, which is the percentage increase of emission factors at the end of the useful life of the engine;
A is the age of the engine when the emissions are estimated;
UL is the vessel type and engine use specific engine useful life;
HP is rated horsepower of the engine;
LF is the vessel type and engine use specific engine load factor;
Hr is the number of annual operating hours of the engine.

Calendar Years	Horsepower Range	Model Years	NOx	PM
2007+	All	2011+	0.948	0.852

Source: ARB, Appendix B. Emissions Estimation Methodology for Commercial Harbor Craft Operating in California

Alternative 2A - Operations - Electric Dredge Emissions

Assumptions

Main Generator Engine	2560	bhp
	1909.0	kW
Aux Generator Engines	750	bhp
	559.3	kW
Total kW	2468.2	

				Emissions (metric tons per year)
Activity	**Number of Construction Days**	**Time (hours per day)**	**Daily Energy Consumption (kWh)**	**CO2e***
Dredge	150	20	49,364.68	2,458.43

	Emission Factors (lb/MWh)
CO_2	720.490
N_2O	0.029
CH_4	0.010

Source: Climate Action Registry, 2012. SDG&E 2009 Annual Entity Emissions: Electric Power Generation/Electric Utility Sector.

Global Warming Potential

Gas	Atmospheric Lifetime (years)	Global Warming Potential (100 year time horizon)
Carbon Dioxide	50-200	1
Methane	12 ± 3	21
Nitrous Oxide	120	310

IPCC, Second Assessment Report. 1995.

Fugitive Dust Emissions - Summary

PM10

Fugitive Dust Emissions (pounds per day)					
Alternative	**Phase 1**	**Phase 2**	**Phase 3**	**Phase 4**	**Total**
2A/1B	40.74	43.69	43.69	31.42	159.54
1A	41.73	23.07	-	-	64.80

Fugitive Dust Emissions (tons)					
Alternative	**Phase 1**	**Phase 2**	**Phase 3**	**Phase 4**	**Total**
2A/1B	6.36	3.67	3.67	1.89	15.58
1A	4.51	0.83	-	-	5.34

PM2.5

Fugitive Dust Emissions (pounds per day)					
Alternative	**Phase 1**	**Phase 2**	**Phase 3**	**Phase 4**	**Total**
2A/1B	2.14	2.30	2.30	1.65	8.39
1A	2.20	1.21	-	-	3.41

Fugitive Dust Emissions (tons)					
Alternative	**Phase 1**	**Phase 2**	**Phase 3**	**Phase 4**	**Total**
2A/1B	0.33	0.19	0.19	0.10	0.82
1A	0.24	0.04	-	-	0.28

Alternative 1A - Phase 1

Daily On-Site Construction Motor Vehicle Fugitive Particulate Matter Emissions												
						Uncontrolled Emission Factors (lb/mi)[b]		Uncontrolled Emissions (lb/day)[c]			Controlled Emissions (lb/day)[f]	
Vehicle Type	No.	Mi/Veh-Day[f]	Surface Type	Silt Loading (g/m^2)/ Silt Content (%)[a]	Vehicle Weight (tons)	PM10	PM2.5	PM10	PM2.5	Control Efficiency[d]	PM10	PM2.5
Dump Truck	85	0.5	Unpaved	6	25	3.97E+00	2.09E-01	168.6	8.9	75%	41.7	2.2

Note: Totals may not match sum of individual values because of rounding.

[a] Unpaved surface silt content from SCAQMD CEQA Handbook, (1993) Table A9-9-D-1 for city and county roads

[b] Equations:

EF (unpaved) = k_u $(s/12)^a$ $(W/3)^b$ Ref: AP-42, Section 13.2.2, "Unpaved Rods," November 2006

Constants:

k_u =	1.5	(Particle size multiplier for PM)
	0.15	(Particle size multiplier for PM2.5)
a =	0.9	for PM10
	0.9	for PM2.5
b =	0.45	for PM10
	0.45	for PM2.5

[c] Uncontrolled emissions [lb/day] = Emission factor [lb/mi] x Number x Daily miles traveled [mi/vehicle-day]

[d] Control efficiency from watering unpaved road twice a day (55%) and limiting maximum speed to 25 mph (44%), from Table XI-A, Mitigation Measure Examples, Fugitive Dust from Construction & Demolition, http://www.aqmd.gov/ceqa/handbook/mitigation/fugitive/MM_fugitive.html

[e] Controlled emissions [lb/day] = Uncontrolled emissions [lb/day] x (1 - Control efficiency [%])

[f] Based on 1 mile roundtrip from Rios Ave to staging area

Alternative 1A - Phase 2

Daily On-Site Construction Motor Vehicle Fugitive Particulate Matter Emissions												
						Uncontrolled Emission Factors (lb/mi)[b]		Uncontrolled Emissions (lb/day)[c]			Controlled Emissions (lb/day)[f]	
Vehicle Type	No.	Mi/Veh-Day[f]	Surface Type	Silt Loading (g/m^2)/ Silt Content (%)[a]	Vehicle Weight (tons)	PM10	PM2.5	PM10	PM2.5	Control Efficiency[d]	PM10	PM2.5
Dump Truck	47	0.5	Unpaved	6	25	3.97E+00	2.09E-01	93.2	4.9	75%	23.1	1.2

Note: Totals may not match sum of individual values because of rounding.

[a] Unpaved surface silt content from SCAQMD CEQA Handbook, (1993) Table A9-9-D-1 for city and county roads

[b] Equations:

EF (unpaved) = k_u $(s/12)^a$ $(W/3)^b$ Ref: AP-42, Section 13.2.2, "Unpaved Rods," November 2006

Constants:

k_u =	1.5	(Particle size multiplier for PM)
	0.15	(Particle size multiplier for PM2.5)
a =	0.9	for PM10
	0.9	for PM2.5
b =	0.45	for PM10
	0.45	for PM2.5

[c] Uncontrolled emissions [lb/day] = Emission factor [lb/mi] x Number x Daily miles traveled [mi/vehicle-day]

[d] Control efficiency from watering unpaved road twice a day (55%) and limiting maximum speed to 25 mph (44%), from Table XI-A, Mitigation Measure Examples, Fugitive Dust from Construction & Demolition, http://www.aqmd.gov/ceqa/handbook/mitigation/fugitive/MM_fugitive.html

[e] Controlled emissions [lb/day] = Uncontrolled emissions [lb/day] x (1 - Control efficiency [%])

[f] Based on average trip distances from paved roadways to staging areas

Alternative 2A/1B - Phase 1

Daily On-Site Construction Motor Vehicle Fugitive Particulate Matter Emissions												
						Uncontrolled Emission Factors (lb/mi)[b]		Uncontrolled Emissions (lb/day)[c]			Controlled Emissions (lb/day)[f]	
Vehicle Type	No.	Mi/Veh-Day[f]	Surface Type	Silt Loading (g/m^2)/ Silt Content (%)[a]	Vehicle Weight (tons)	PM10	PM2.5	PM10	PM2.5	Control Efficiency[d]	PM10	PM2.5
Dump Truck	83	0.5	Unpaved	6	25	3.97E+00	2.09E-01	164.6	8.7	75%	40.7	2.1

Note: Totals may not match sum of individual values because of rounding.

[a] Unpaved surface silt content from SCAQMD CEQA Handbook, (1993) Table A9-9-D-1 for city and county roads

[b] Equations:

EF (unpaved) = k_u $(s/12)^a$ $(W/3)^b$ Ref: AP-42, Section 13.2.2, "Unpaved Rods," November 2006

Constants:

k_u =	1.5	(Particle size multiplier for PM)
	0.15	(Particle size multiplier for PM2.5)
a =	0.9	for PM10
	0.9	for PM2.5
b =	0.45	for PM10
	0.45	for PM2.5

[c] Uncontrolled emissions [lb/day] = Emission factor [lb/mi] x Number x Daily miles traveled [mi/vehicle-day]

[d] Control efficiency from watering unpaved road twice a day (55%) and limiting maximum speed to 25 mph (44%), from Table XI-A, Mitigation Measure Examples, Fugitive Dust from Construction & Demolition, http://www.aqmd.gov/ceqa/handbook/mitigation/fugitive/MM_fugitive.html

[e] Controlled emissions [lb/day] = Uncontrolled emissions [lb/day] x (1 - Control efficiency [%])

[f] Based on average trip distances from paved roadways to staging areas

Alternative 2A/1B - Phase 2

Daily On-Site Construction Motor Vehicle Fugitive Particulate Matter Emissions												
						Uncontrolled Emission Factors (lb/mi)[b]		Uncontrolled Emissions (lb/day)[c]			Controlled Emissions (lb/day)[f]	
Vehicle Type	No.	Mi/Veh-Day[f]	Surface Type	Silt Loading (g/m^2)/ Silt Content (%)[a]	Vehicle Weight (tons)	PM10	PM2.5	PM10	PM2.5	Control Efficiency[d]	PM10	PM2.5
Dump Truck	89	0.5	Unpaved	6	25	3.97E+00	2.09E-01	176.5	9.3	75%	43.7	2.3

Note: Totals may not match sum of individual values because of rounding.

[a] Unpaved surface silt content from SCAQMD CEQA Handbook, (1993) Table A9-9-D-1 for city and county roads

[b] Equations:

EF (unpaved) = k_u $(s/12)^a$ $(W/3)^b$ Ref: AP-42, Section 13.2.2, "Unpaved Rods," November 2006

Constants:

k_u =	1.5	(Particle size multiplier for PM)
	0.15	(Particle size multiplier for PM2.5)
a =	0.9	for PM10
	0.9	for PM2.5
b =	0.45	for PM10
	0.45	for PM2.5

[c] Uncontrolled emissions [lb/day] = Emission factor [lb/mi] x Number x Daily miles traveled [mi/vehicle-day]

[d] Control efficiency from watering unpaved road twice a day (55%) and limiting maximum speed to 25 mph (44%), from Table XI-A, Mitigation Measure Examples, Fugitive Dust from Construction & Demolition, http://www.aqmd.gov/ceqa/handbook/mitigation/fugitive/MM_fugitive.html

[e] Controlled emissions [lb/day] = Uncontrolled emissions [lb/day] x (1 - Control efficiency [%])

[f] Based on average trip distances from paved roadways to staging areas

Alternative 2A/1B - Phase 3

Daily On-Site Construction Motor Vehicle Fugitive Particulate Matter Emissions												
						Uncontrolled Emission Factors (lb/mi)[b]		Uncontrolled Emissions (lb/day)[c]			Controlled Emissions (lb/day)[f]	
Vehicle Type	No.	Mi/Veh-Day[f]	Surface Type	Silt Loading (g/m^2)/ Silt Content (%)[a]	Vehicle Weight (tons)	PM10	PM2.5	PM10	PM2.5	Control Efficiency[d]	PM10	PM2.5
Dump Truck	89	0.5	Unpaved	6	25	3.97E+00	2.09E-01	176.5	9.3	75%	43.7	2.3

Note: Totals may not match sum of individual values because of rounding.

[a] Unpaved surface silt content from SCAQMD CEQA Handbook, (1993) Table A9-9-D-1 for city and county roads

[b] Equations:

EF (unpaved) = k_u $(s/12)^a$ $(W/3)^b$ Ref: AP-42, Section 13.2.2, "Unpaved Rods," November 2006

Constants:

k_u =	1.5	(Particle size multiplier for PM)
	0.15	(Particle size multiplier for PM2.5)
a =	0.9	for PM10
	0.9	for PM2.5
b =	0.45	for PM10
	0.45	for PM2.5

[c] Uncontrolled emissions [lb/day] = Emission factor [lb/mi] x Number x Daily miles traveled [mi/vehicle-day]

[d] Control efficiency from watering unpaved road twice a day (55%) and limiting maximum speed to 25 mph (44%), from Table XI-A, Mitigation Measure Examples, Fugitive Dust from Construction & Demolition, http://www.aqmd.gov/ceqa/handbook/mitigation/fugitive/MM_fugitive.html

[e] Controlled emissions [lb/day] = Uncontrolled emissions [lb/day] x (1 - Control efficiency [%])

[f] Based on average trip distances from paved roadways to staging areas

Alternative 2A/1B - Phase 4

Daily On-Site Construction Motor Vehicle Fugitive Particulate Matter Emissions												
						Uncontrolled Emission Factors (lb/mi)[b]		Uncontrolled Emissions (lb/day)[c]			Controlled Emissions (lb/day)[f]	
Vehicle Type	No.	Mi/Veh-Day[f]	Surface Type	Silt Loading (g/m^2)/ Silt Content (%)[a]	Vehicle Weight (tons)	PM10	PM2.5	PM10	PM2.5	Control Efficiency[d]	PM10	PM2.5
Dump Truck	64	0.5	Unpaved	6	25	3.97E+00	2.09E-01	126.9	6.7	75%	31.4	1.7

Note: Totals may not match sum of individual values because of rounding.

[a] Unpaved surface silt content from SCAQMD CEQA Handbook, (1993) Table A9-9-D-1 for city and county roads

[b] Equations:

EF (unpaved) = k_u $(s/12)^a$ $(W/3)^b$ Ref: AP-42, Section 13.2.2, "Unpaved Rods," November 2006

Constants:

k_u =	1.5	(Particle size multiplier for PM)
	0.15	(Particle size multiplier for PM2.5)
a =	0.9	for PM10
	0.9	for PM2.5
b =	0.45	for PM10
	0.45	for PM2.5

[c] Uncontrolled emissions [lb/day] = Emission factor [lb/mi] x Number x Daily miles traveled [mi/vehicle-day]

[d] Control efficiency from watering unpaved road twice a day (55%) and limiting maximum speed to 25 mph (44%), from Table XI-A, Mitigation Measure Examples, Fugitive Dust from Construction & Demolition, http://www.aqmd.gov/ceqa/handbook/mitigation/fugitive/MM_fugitive.html

[e] Controlled emissions [lb/day] = Uncontrolled emissions [lb/day] x (1 - Control efficiency [%])

[f] Based on average trip distances from paved roadways to staging areas

San Diego 2015 On-Road Emission Factors

VEH	FUEL	MDLYR	SPEED	POP	VMT	TRIPS	ROG_RUNEX	CO_RUNEX	NOX_RUNEX	CO2_RUNEX	PM10_Total	PM2_5_Total	CH4	N2O
			(Miles/hr)	(Vehicles)	(Miles/day)	(Trips/day)	(gms/mile)	(gms/mile)	(gms/mile)	(gms/mile)	(gms/mile)	(gms/mile)	(gms/mile)	(gms/mile)
LDA	GAS	AllMYr	AllSpeeds	1,169,183	42,600,784	7,361,744	0.045	1.290	0.136	302.103	0.047	0.019		
LDA	DSL	AllMYr	AllSpeeds	5,466	179,217	31,713	0.038	0.215	0.576	315.879	0.072	0.043		
LDT1	GAS	AllMYr	AllSpeeds	172,849	6,187,163	1,061,257	0.075	2.505	0.269	357.183	0.048	0.021		
LDT1	DSL	AllMYr	AllSpeeds	210	6,180	1,102	0.066	0.312	0.691	314.863	0.099	0.068		
LDT2	GAS	AllMYr	AllSpeeds	423,444	16,224,269	2,675,455	0.037	1.498	0.192	432.459	0.047	0.019		
LDT2	DSL	AllMYr	AllSpeeds	187	5,979	1,022	0.046	0.252	0.690	323.109	0.080	0.050		
Average							0.051	1.012	0.426	340.933	0.066	0.037	0.028	0.037

Source: EMFAC 2011

VEH	FUEL	MDLYR	SPEED	POP	VMT	TRIPS	ROG_RUNEX	CO_RUNEX	NOX_RUNEX	CO2_RUNEX	PM10_Total	PM2_5_Total	CH4	N2O
			(Miles/hr)	(Vehicles)	(Miles/day)	(Trips/day)	(gms/mile)	(gms/mile)	(gms/mile)	(gms/mile)	(gms/mile)	(gms/mile)	(gms/mile)	(gms/mile)
T7 tractor	DSL	AllMYr	AllSpeeds	2,454	392,614	0	0.296	1.343	8.984	1699.527	0.231	0.158	0.0051	0.0048

Source: EMFAC 2011

San Diego 2020 On-Road Emission Factors

VEH	FUEL	MDLYR	SPEED (Miles/hr)	POP (Vehicles)	VMT (Miles/day)	TRIPS (Trips/day)	ROG_RUNEX (gms/mile)	CO_RUNEX (gms/mile)	NOX_RUNEX (gms/mile)	CO2_RUNEX (gms/mile)	PM10_Total (gms/mile)	PM2_5_Total (gms/mile)	CH4 (gms/mile)	N2O (gms/mile)
LDA	GAS	AllMYr	AllSpeeds	1,261,438	46,436,329	7,971,039	0.03	0.10	0.83	244.16	0.05	0.02		
LDA	DSL	AllMYr	AllSpeeds	5,897	203,726	36,279	0.02	0.39	0.13	265.72	0.06	0.03		
LDT1	GAS	AllMYr	AllSpeeds	186,176	6,674,684	1,134,440	0.04	0.17	1.56	297.84	0.05	0.02		
LDT1	DSL	AllMYr	AllSpeeds	226	8,187	1,308	0.03	0.45	0.17	259.42	0.07	0.04		
LDT2	GAS	AllMYr	AllSpeeds	450,141	17,355,693	2,832,803	0.02	0.11	0.93	364.76	0.05	0.02		
LDT2	DSL	AllMYr	AllSpeeds	199	7,528	1,228	0.02	0.47	0.14	280.32	0.06	0.03		
Average							0.026	0.283	0.626	285.370	0.055	0.027	0.028	0.037

Source: EMFAC 2011

VEH	FUEL	MDLYR	SPEED (Miles/hr)	POP (Vehicles)	VMT (Miles/day)	TRIPS (Trips/day)	ROG_RUNEX (gms/mile)	CO_RUNEX (gms/mile)	NOX_RUNEX (gms/mile)	CO2_RUNEX (gms/mile)	PM10_Total (gms/mile)	PM2_5_Total (gms/mile)	CH4 (gms/mile)	N2O (gms/mile)
T7 tractor	DSL	AllMYr	AllSpeeds	3,262	531,839	-	0.22	1.02	4.20	1553.04	0.18	0.11	0.0051	0.0048

Source: EMFAC 2011